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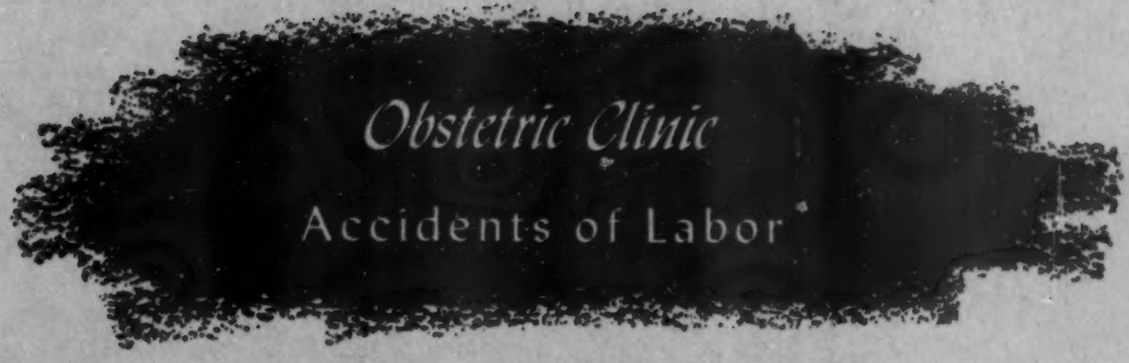

September 1953

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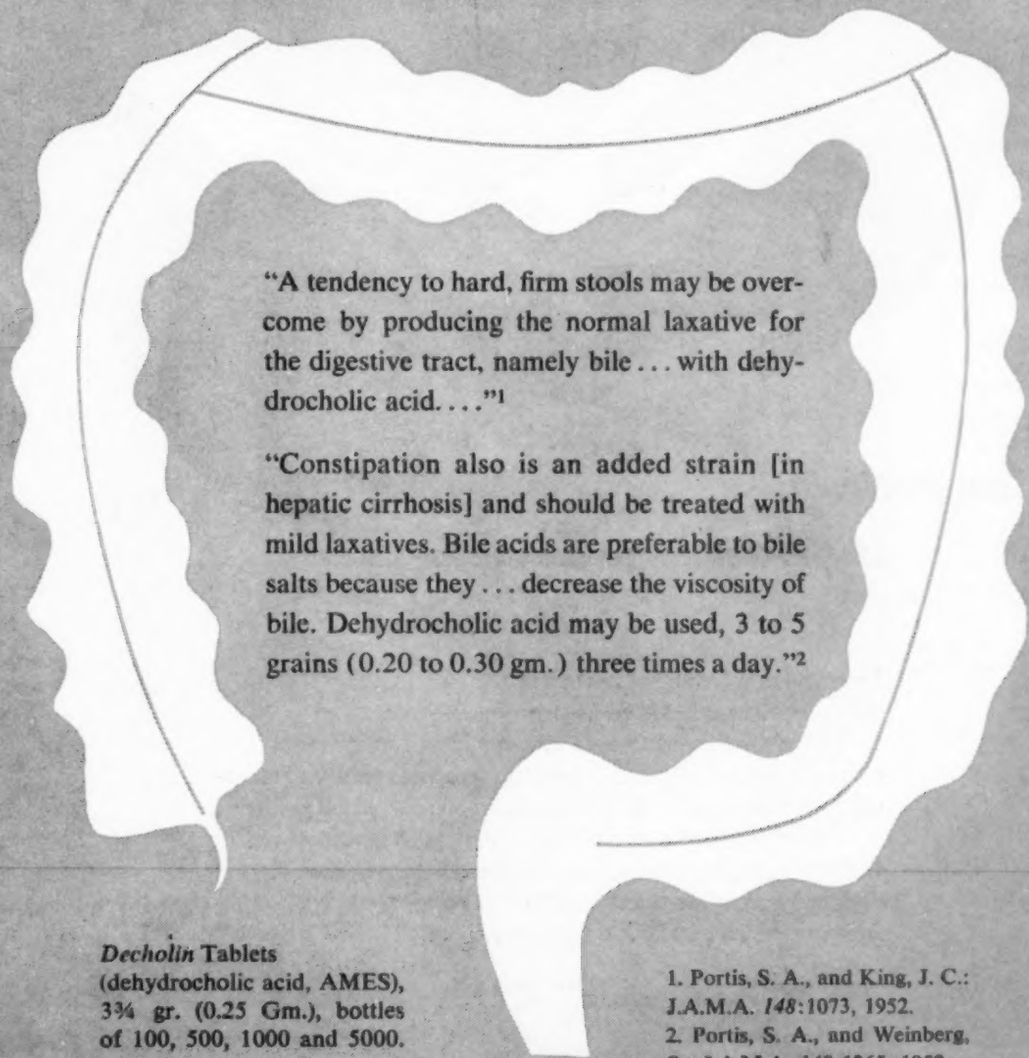

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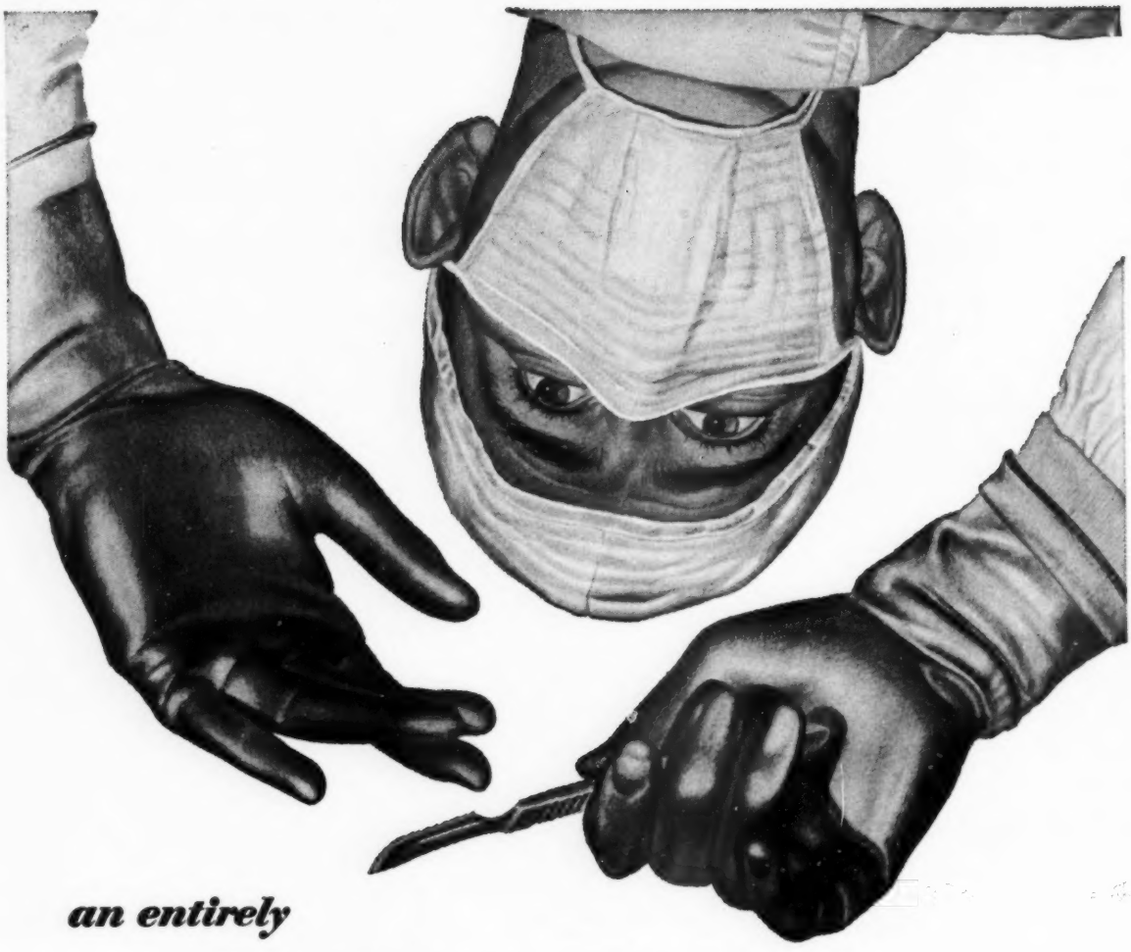

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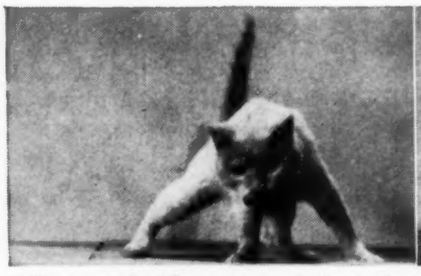
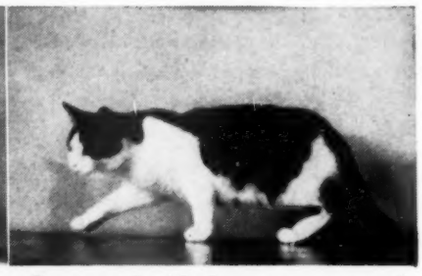
New principle
in
Streptomycin Therapy

The hazard of ototoxicity is greatly reduced by combining equal parts of streptomycin sulfate and dihydrostreptomycin sulfate. The patient thus gets only *half* as much of each drug. The risk of vestibular damage (from streptomycin) and of hearing loss (from dihydrostreptomycin) is greatly reduced. Therapeutic effect is undiminished. This principle has been demonstrated in both animals and man. In patients treated for 120 days with 1 Gm. per day of the combined drugs, the incidence of neurotoxicity was practically zero.



Cat treated with streptomycin is ataxic.



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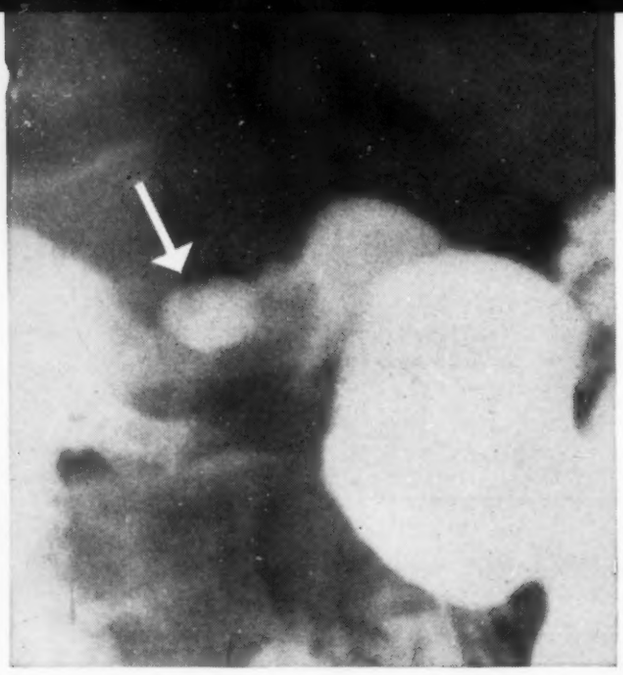

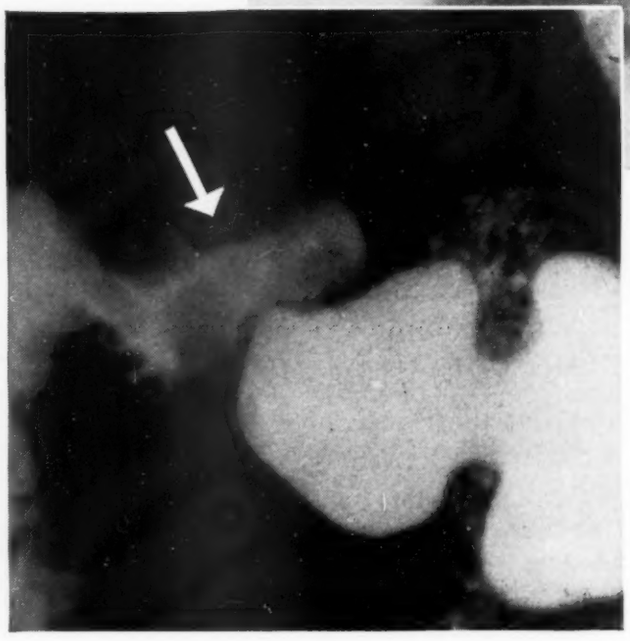

Top left: "X-rays revealed a huge ulcer crater in the duodenal bulb."

Top right: "Twelve days later the crater was strikingly reduced in size."

Bottom: "Two weeks later another spot roentgenogram revealed complete healing."

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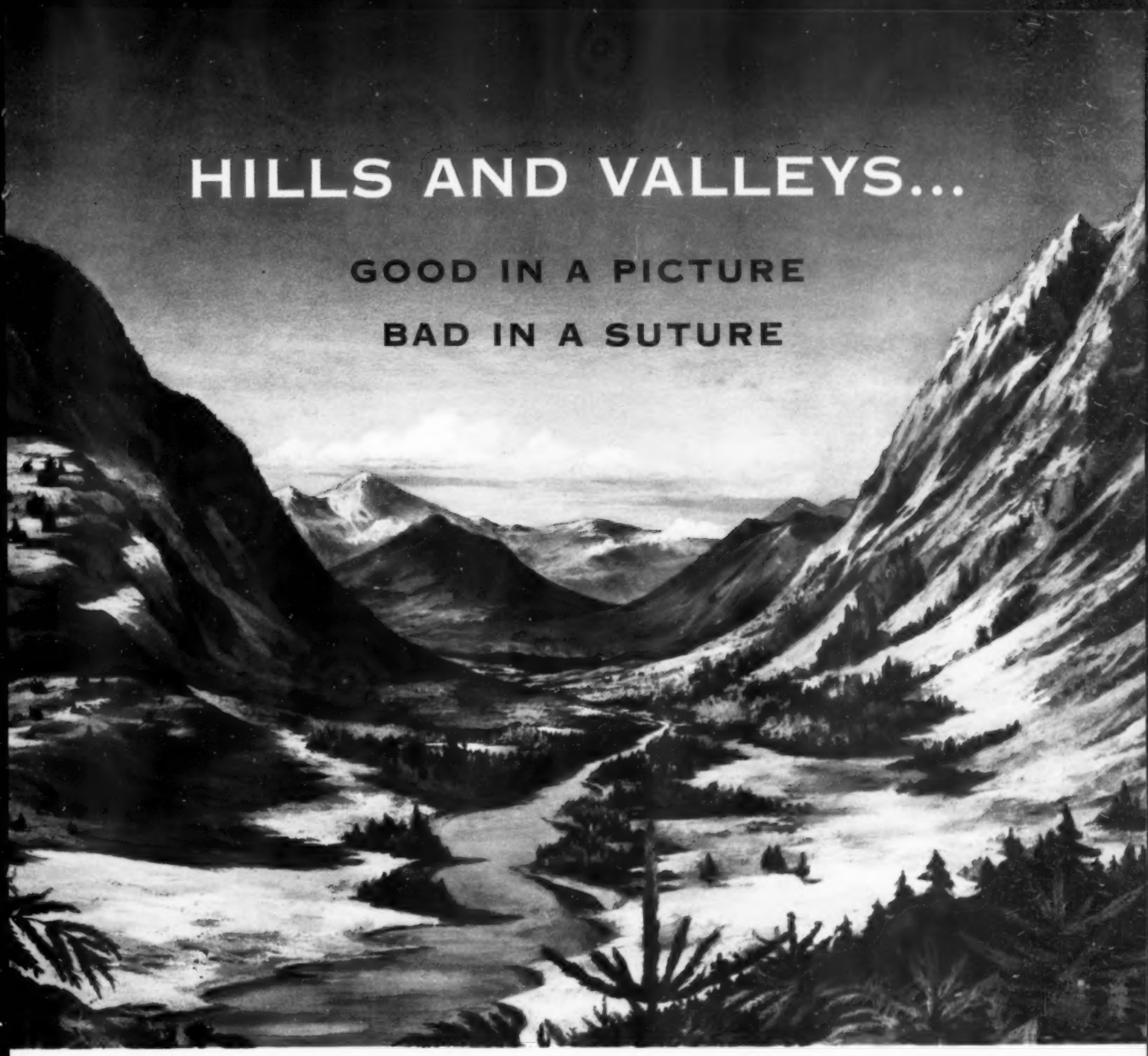

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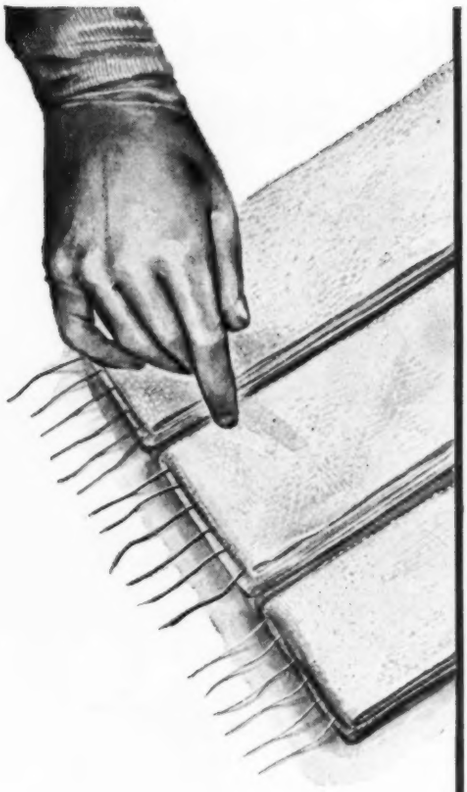

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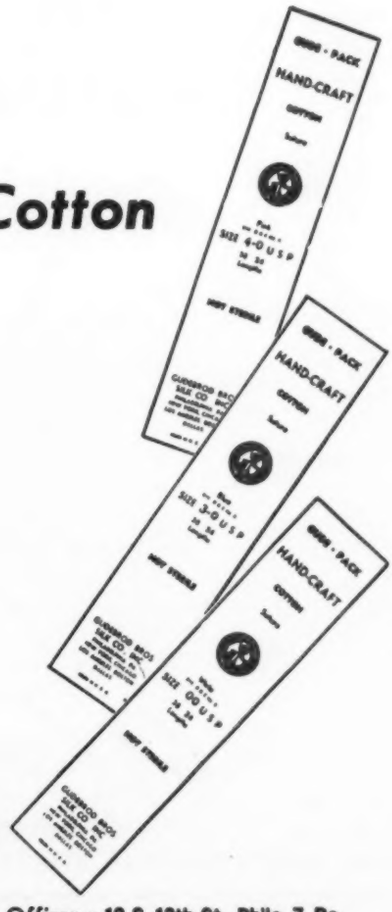

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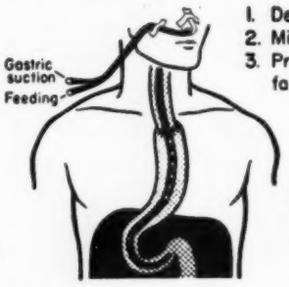

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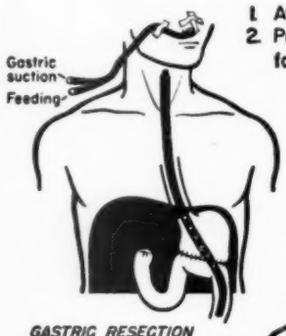

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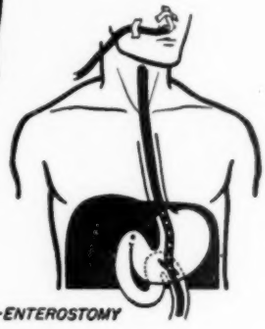

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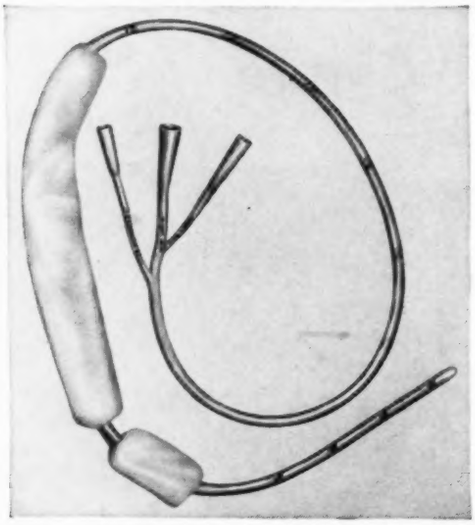

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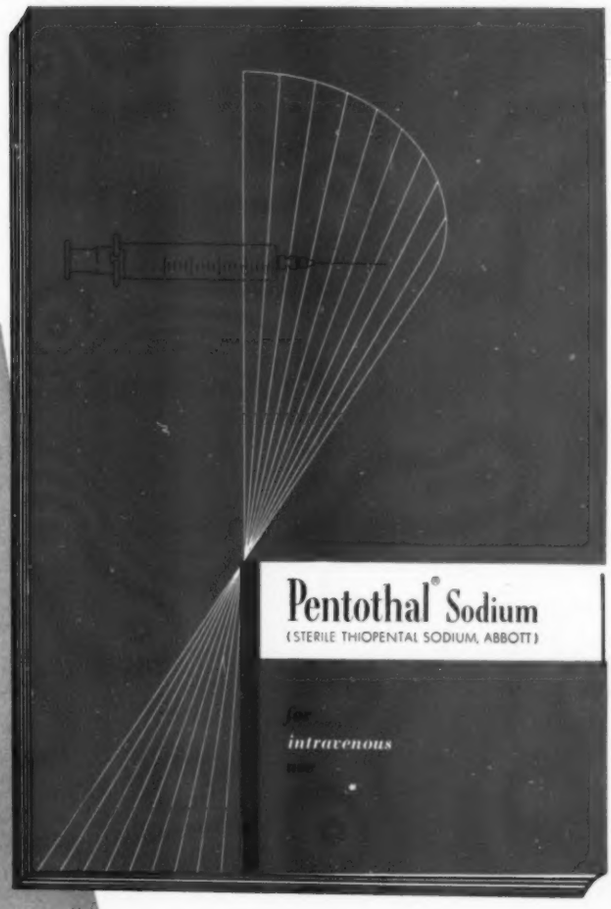

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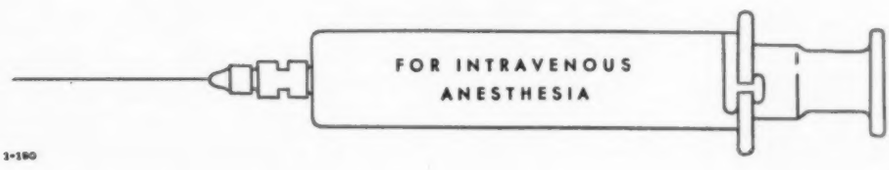

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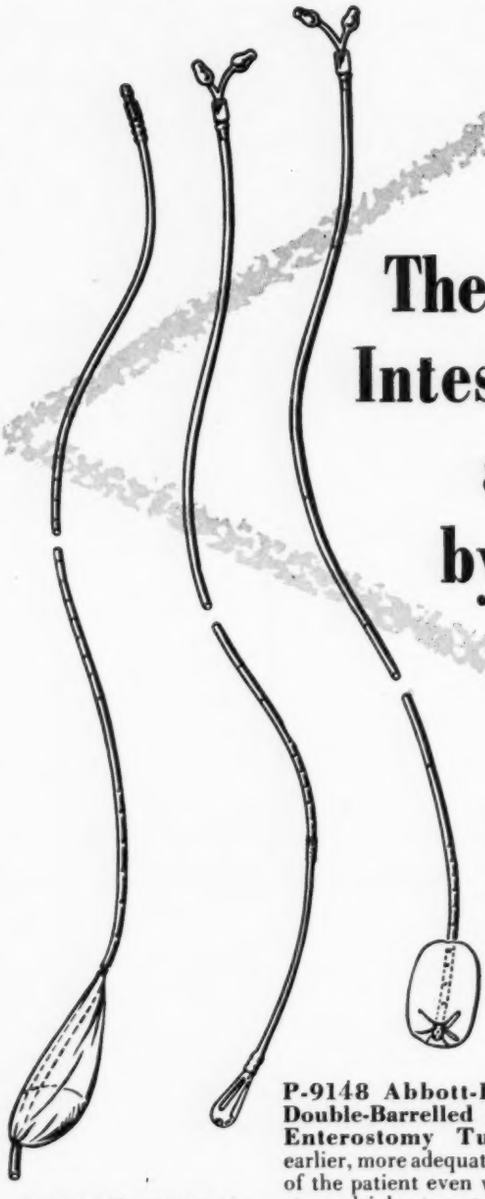

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P-9140 Miller-Abbott Double-Lumen Tube for small intestinal intubation. With balloon proximal to perforated metal end. In several styles for special uses. Complete range of sizes: 12, 14, 16, and 18 Fr. Write for full details.

P-9148 Abbott-Rawson Double-Barrelled Gastro-Enterostomy Tube for earlier, more adequate feeding of the patient even while the stomach is kept empty. Double lumen—permitting simultaneous aspiration of the stomach and jejunal feeding. Supplied complete with sterling silver bucket. 14 and 16 Fr.

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for simple effective conception control

"...the over-all acceptability of the product is an outstanding feature."*

"...the convenient method of use of Preceptin recommends it to the doctor."*

*Stromme, W. B., and Rothnem, M. S.: Clinical Experience with a New Gel-Alone Method of Contraception. World Population Problems and Birth Control, Ann. New York Acad. Sc. 54:831 (May) 1952.

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Ortho-Gynol® vaginal jelly—ricinoleic acid 0.7%, boric acid 3.00%, oxyquinoline sulphate 0.025%, p-Diisobutylphenoxypolyethoxyethanol 1.00%
Ortho® Creme vaginal cream—ricinoleic acid 0.75%, boric acid 2.00%, sodium lauryl sulphate 0.28%

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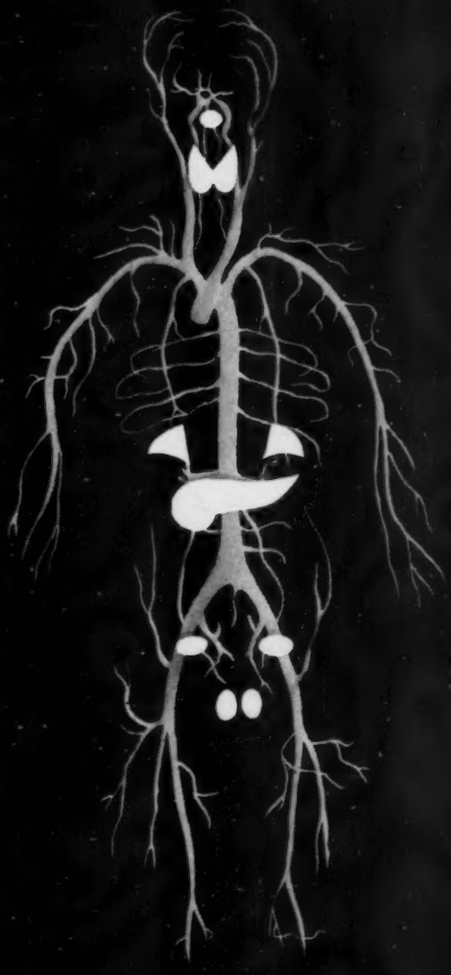
endocrine
readjustment
is
a key
to
well-being



Pfizer

Syntex

you can now specify Pfizer Syntex oral, transmucosal and injectable preparations of androgens, estrogens, progesterone and combinations widely useful in practice today

Arrangements recently completed between the Pfizer and Syntex Organization now make possible a complete line of steroid hormone preparations available from PFIZER LABORATORIES. On the facing page are listed the initial groups of Pfizer Syntex preparations you can now specify, including Neodrol,* the newest agent for anabolic effect and tumor-suppression in selected cases with minimal virilizing side effects.

Research, discovery, development and wide clinical acceptance have distinguished Pfizer antibiotic agents, so often the choice of physicians in the control of infectious disease. The scientific research facilities and production controls of both Pfizer and Syntex assure the unsurpassed purity, potency and clinical excellence of the steroid hormone preparations supplied by PFIZER LABORATORIES.

Additional information on these specialties and their roles in your practice may be obtained by writing directly to Medical Service Department, PFIZER LABORATORIES, Division, Chas. Pfizer & Co., Inc., 630 Flushing Avenue, Brooklyn 6, N.Y.

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SYNANDROTABS*	Methyl Testosterone, U.S.P., Tablets 10 mg. and 25 mg.
SYNANDRETS*	Testosterone, U.S.P., Transmucosal Tablets 10 mg. and 25 mg.
SYNANDROL*	Testosterone Propionate, U.S.P., in Sesame Oil 25 mg., 50 mg. and 100 mg. per cc.; in single-dose disposable STERAJECT® cartridges and in 10 cc. multiple-dose vials
SYNANDROL*-F	Testosterone, U.S.P., in Aqueous Suspension 25 mg., 50 mg. and 100 mg. per cc.; in 10 cc. multiple-dose vials
DIOGYNETS*	Estradiol, U.S.P., Transmucosal Tablets 0.125 mg., 0.25 mg. and 1.0 mg.
DIOGYN*-E	Ethinyl Estradiol Tablets 0.02 mg., 0.05 mg. and 0.5 mg.
DIOGYN*	Estradiol, U.S.P., in Aqueous Suspension 0.25 mg. and 1.0 mg. per cc.; in single-dose disposable STERAJECT cartridges and in 10 cc. multiple-dose vials
DIOGYN*-B	Estradiol Benzoate, U.S.P., in Sesame Oil 0.33 mg. and 1.0 mg. per cc.; in 10 cc. multiple-dose vials
ESTRONE	Estrone, U.S.P., in Aqueous Suspension 2 mg. and 5 mg. per cc.; in 10 cc. multiple-dose vials
SYNGESTROTABS*	Ethisterone, U.S.P., Tablets 10 mg., 25 mg. and 50 mg.
SYNGESTRETS*	Progesterone, U.S.P., Transmucosal Tablets 10 mg., 20 mg. and 50 mg.
SYNGESTERONE* IN SESAME OIL	Progesterone, U.S.P., in Sesame Oil 10 mg., 25 mg., 50 mg. and 100 mg. per cc.; in single-dose disposable STERAJECT cartridges and in 10 cc. multiple-dose vials
SYNGESTERONE* IN AQUEOUS SUSPENSION	Progesterone, U.S.P., in Aqueous Suspension 25 mg. and 50 mg. per cc.; in 10 cc. multiple-dose vials
COMBANDRIN*	Estradiol Benzoate, U.S.P., 1 mg. and Testosterone Propionate, U.S.P., in Sesame Oil 20 mg. per cc. In single-dose disposable STERAJECT cartridges and in 10 cc. multiple-dose vials
COMBANDRETS*	Estradiol, U.S.P., 1 mg. and Testosterone, U.S.P., 10 mg. per Transmucosal Tablet
NEODROL*	Stanolone in Aqueous Suspension 50 mg. per cc.; in 10 cc. multiple-dose vials

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PFIZER LABORATORIES *Brooklyn 6, New York*

DIVISION, CHAS. PFIZER & CO., INC.

Upjohn

enhance anabolism...

Depo-Testosterone

Trademark Reg. U.S. Pat. Off.

CYCLOPENTYLPROPIONATE

ACCEPTED COUNCIL ON PHARMACY AND CHEMISTRY AMERICAN MEDICAL ASSOCIATION

Each cc. contains:

Testosterone Cyclopentylpropionate .....50 mg. or 100 mg.
Chlorobutanol.....5 mg.
Cottonseed Oil.....q.s.

50 mg. per cc. available in 10 cc. vials

100 mg. per cc. available in 1 cc. and 10 cc. vials

The Upjohn Company, Kalamazoo, Michigan

NEW

Davis & Geck's Spiral Wound Surgical Gut on a cylindrical reel!

Saves time makes easier ties

Surgeons welcome a new convenience—D & G Spiral Wound Surgical Gut. It is wound on a cylindrical reel—comes *ready for immediate use* in ligation and suturing. Spiral winding preserves all the original strength. None is lost through kinks or bends.

Nurses, too, save time with Spiral Wound Gut. No more unwinding from an old style flat reel and rewinding onto a rubber tube, glass rod or spindle.

For surer hand ties

When the surgeon makes a series of hand ties, D & G Spiral Wound Surgical Gut USP unreels in his hand, free from kinks, with all its tensile strength preserved.

The gut should be gently pulled out straight immediately after removal from the tube.

D & G foresees the surgeon's needs

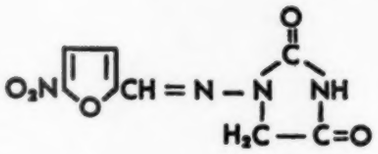
D & G Spiral Wound Gut is the latest Davis & Geck contribution to improved suturing. "Timed-absorption" surgical gut is another—this exclusive D & G method embodies accurately graded degrees of chromicizing. The suture resists digestion most strongly during the first postoperative days, when greatest strength is needed. It is absorbed more rapidly when tissues have regained their natural strength.

Davis & Geck, Inc.

A UNIT OF AMERICAN Cyanamid COMPANY

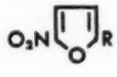
57 Willoughby Street, Brooklyn 1, N.Y.

A NEW CHEMOTHERAPEUTIC MOLECULE TAILORED SPECIFICALLY FOR REFRACTORY URINARY TRACT INFECTIONS

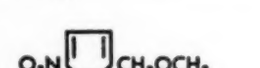


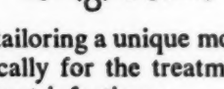
Discovery of the antimicrobial properties of the nitrofurans provided a novel class of chemotherapeutic agents. These compounds possess specific antibacterial activity with low toxicity for human tissues.

The simplicity and flexibility of this nitrofuran nucleus make possible numerous variations of its chemical and therapeutic characteristics; a remedy may be tailored to fit the disease.



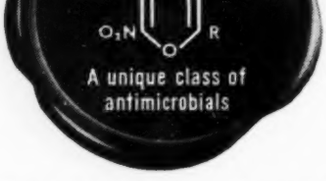
Within recent years we have so designed two important antimicrobial nitrofurans for topical use: Furacin brand of nitrofurazone and Furaspor brand of nitrofurfuryl methyl ether.





Now we have succeeded in chemically tailoring a unique molecule, designed specifically for the treatment of bacterial urinary tract infections:

The NITROFURANS



A unique class of antimicrobials

Products of Eaton Research

FURADANTIN®

Brand of nitrofurantoin:
N-(5-nitro-2-furfurylidene)-1-aminohydantoin.

for **pyelonephritis**
cystitis
pyelitis

which have proven refractory to other antibacterial agents:

FURADANTIN

provides definite advantages:

- clinical effectiveness against most of the bacteria of urinary tract infections, *including many strains of Proteus, Aerobacter and Pseudomonas species*
- low blood level–bactericidal urinary concentration
- effective in blood, pus and urine–independent of pH
- limited development of bacterial resistance
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- stable
- oral administration
- low incidence of nausea–*no* abdominal pain–*no* proctitis or pruritus–*no* crystalluria or hematuria
- non-irritating–no cytotoxicity–no inhibition of phagocytosis
- *tailored specifically for urologic use*

Scored tablets of 50 & 100 mg.
Now available on prescription
Write for comprehensive literature

EATON LABORATORIES Inc.
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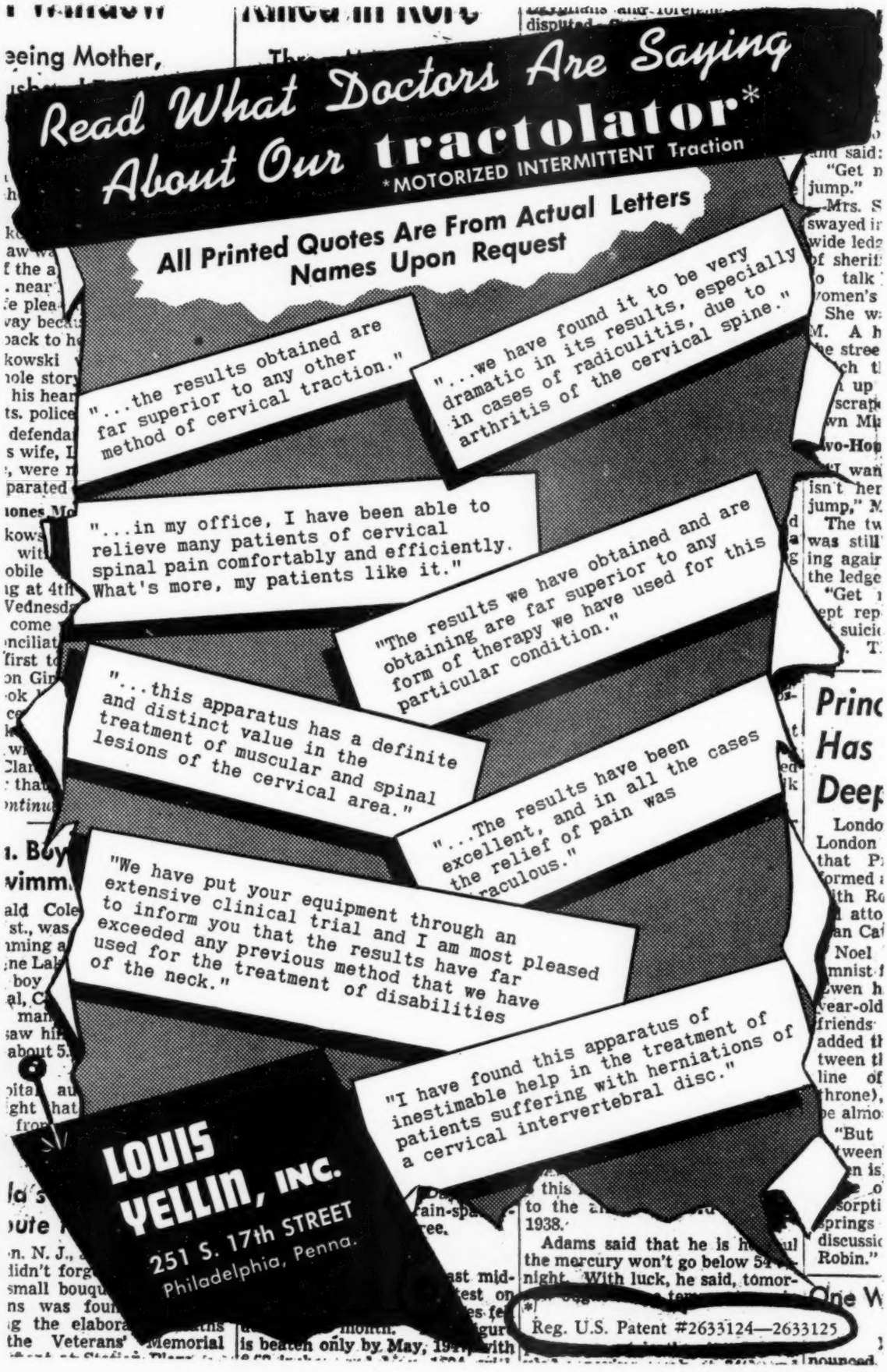
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"...the results obtained are far superior to any other method of cervical traction."
"...we have found it to be very dramatic in its results, especially in cases of radiculitis, due to arthritis of the cervical spine."
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"The results we have obtained and are obtaining are far superior to any form of therapy we have used for this particular condition."
"...this apparatus has a definite and distinct value in the treatment of muscular and spinal lesions of the cervical area."
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raculous."
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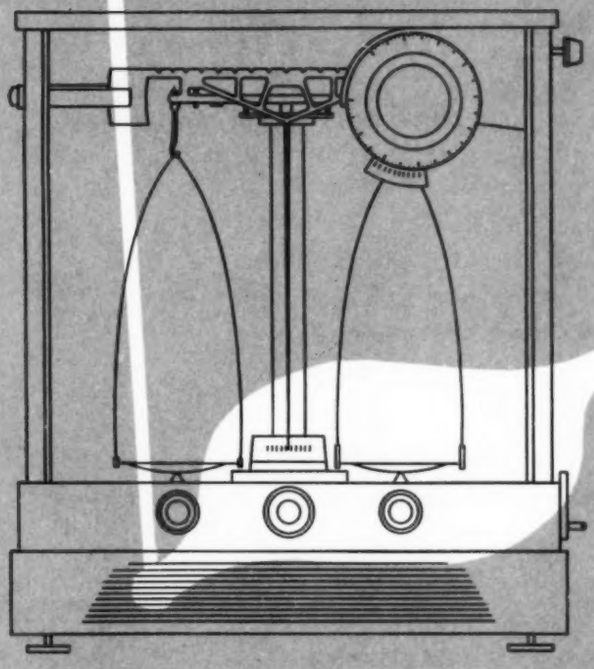
for a balanced program of parenteral nutrition . . .



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Travert® 10%-Electrolyte

SOLUTIONS

. . .to supply increased carbohydrate

. . .to maintain electrolyte balance

5 NEW

Travert® 10%-Electrolyte solutions

all the advantages of Travert* plus replacement of electrolytes, and correction of acidosis and alkalosis

Travert-Electrolyte No. 1 1000 CC. CONTAINERS

(Na-80.0 mEq/liter, K-36.0 mEq, Ca-4.6 mEq, Cl-63.0 mEq, Lactate-60.0 mEq, Mg-2.8 mEq, Travert 10%)

. . . to supply electrolytes and correct mild acidosis

Travert-Electrolyte No. 2 500 CC. AND 1000 CC. CONTAINERS

(Na-57.0 mEq/liter, K-25.0 mEq, Cl-50.0 mEq, Lactate-25.0 mEq, Mg-6.0 mEq, HPO_4-12.5 mEq, Travert 10%)

. . . to furnish electrolytes when neither acidosis nor alkalosis is a problem

Travert-Electrolyte No. 3 1000 CC. CONTAINERS

(Na-63.0 mEq/liter, K-17.5 mEq, Cl-150.5mEq, NH_4-70.0 mEq, Travert 10%)

. . . to supply electrolytes and correct mild alkalosis

Travert-Potassium 150 CC. AND 1000 CC. CONTAINERS

(K-40.0 mEq/liter, Cl-40.0 mEq, Travert 10%)

. . . to correct hypopotassemia where sodium is not necessary

Travert-Potassium in Half Normal Saline 1000 CC. CONTAINERS

(Na-77.0 mEq/liter, K-40.0 mEq, Cl-117.0 mEq, Travert 10%)

. . . to correct potassium and sodium deficiencies

***Travert 10% Solutions provide:**

twice as many calories as 5% Dextrose, in equal infusion time, with no increase in fluid volume; a greater protein-sparing action as compared to Dextrose; maintenance of hepatic function

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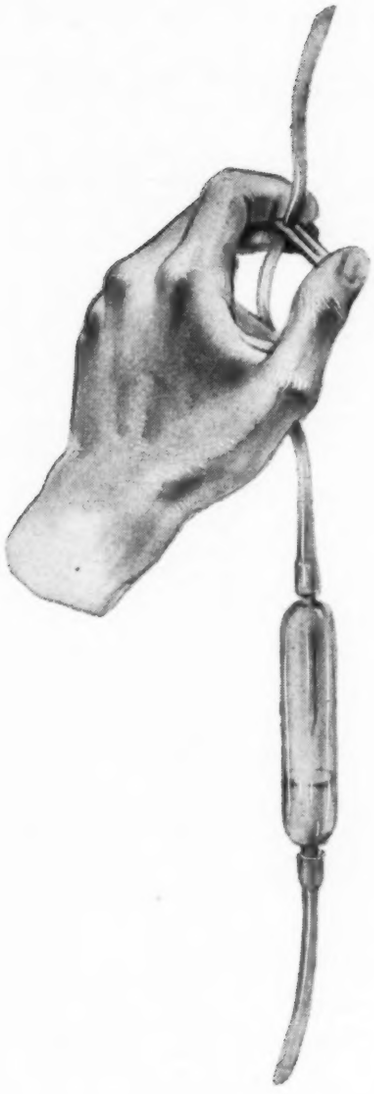


control

degree and duration of muscle relaxation

Controllability is the outstanding advantage of 'Anectine'. It is the result of rapid onset of action, followed by rapid inactivation of the drug by hydrolysis.

Response to alteration of the rate of flow of an intravenous drip of 'Anectine' is apparent in 30 to 60 seconds; therefore the rate required to provide adequate flaccidity, yet retain spontaneous respiration, is quickly determined. Relaxation can then be increased or decreased, within a matter of seconds, according to operative needs. Recovery of muscle tone begins immediately on stopping the infusion.

Speed, both in onset of action and recovery, characterizes single injections of 'Anectine'. So administered, it is dramatically effective for overcoming laryngospasm and for facilitating endotracheal intubation.

'Anectine' *Chloride brand*

SUCCINYLCHOLINE CHLORIDE

Injection . . . 20 mg. in each cc.
Multiple-dose vials of 10 cc.
Ready for intravenous injection.

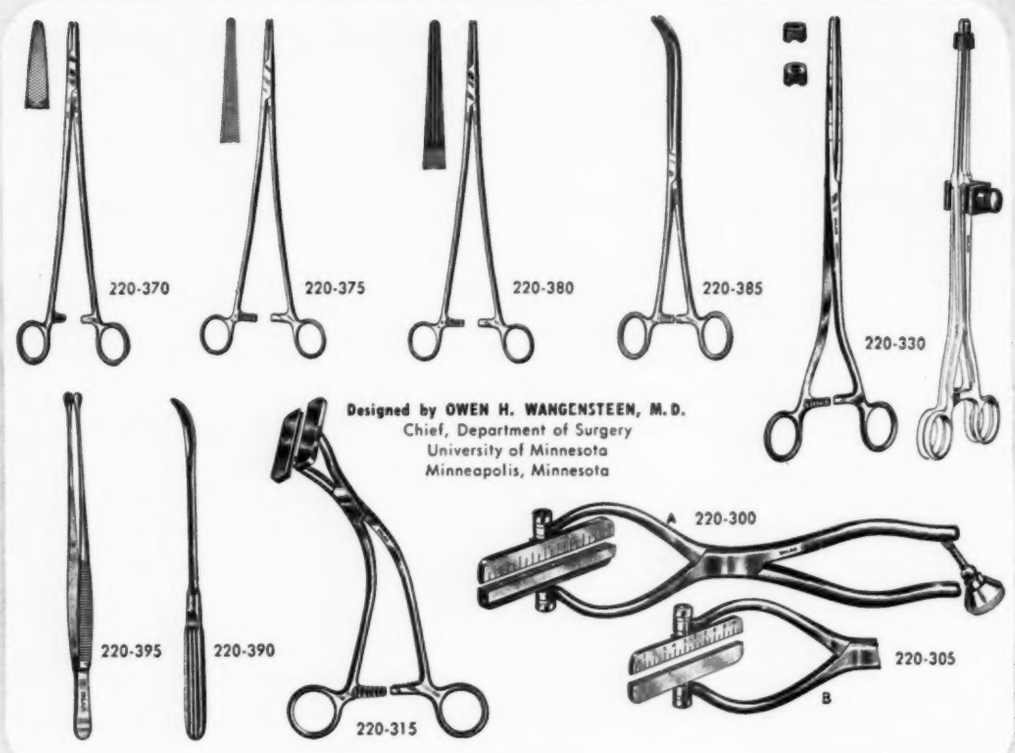
Solution . . . 50 mg. in each cc.
Ampuls of 10 cc.
To be diluted for preparation of intravenous drip solution.

For full information, write to —

Burroughs Wellcome & Co. (U. S. A.) Inc., *Tuckahoe 7, N. Y.*

WANGENSTEEN
GASTRO-INTESTINAL INSTRUMENTS

STAINLESS STEEL...AMERICAN MADE



Designed by OWEN H. WANGENSTEEN, M.D.
Chief, Department of Surgery
University of Minnesota
Minneapolis, Minnesota

Representing another forward step in progressive service to the profession, these Wangensteen gastro-intestinal instruments are truly BETTER INSTRUMENTS FOR MODERN SURGERY.

No. 220-300. Gastric Crushing Clamp "A" with resection ledge, width of jaws 11 cm, total length 11 inches.

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No. 220-390. Dissector and Ligature Carrier, length 9½ inches.

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***Also:* No. 220-320,** Ligature Carrier, length 12 inches and **No. 220-325,** Tissue Inverter (neither illustrated).

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CAUTION! If the name SKLAR is not stamped on the instrument, it is not a genuine Sklar Product.

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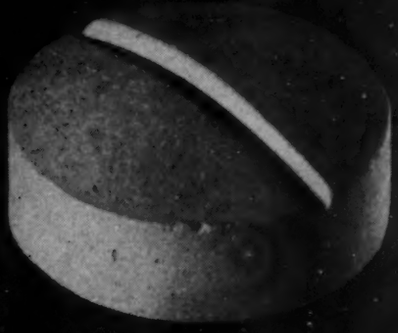

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Aureomycin HCl	125 mg.
Sulfadiazine	167 mg.
Sulfamerazine	167 mg.
Sulfamethazine	167 mg.

For convenience of the physician . . . for convenience of the patient . . . four powerful antibacterial agents are now combined in this one Lederle tablet.

The additive effect of these drugs makes AUREOMYCIN TRIPLE SULFAS TABLETS outstanding for use against gonococcal infections and against dysentery caused by *Shigellae*.

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Aureomycin Triple Sulfas

TABLETS LEDERLE

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1682 brings special finesse to skin suturing

Your patient often judges your operation by the appearance of the skin incision and the final scar. With D & G's product 1682, you accurately coapt the skin edges of a wound on the face, neck, breast or extremities and are sure of minimal scarring.

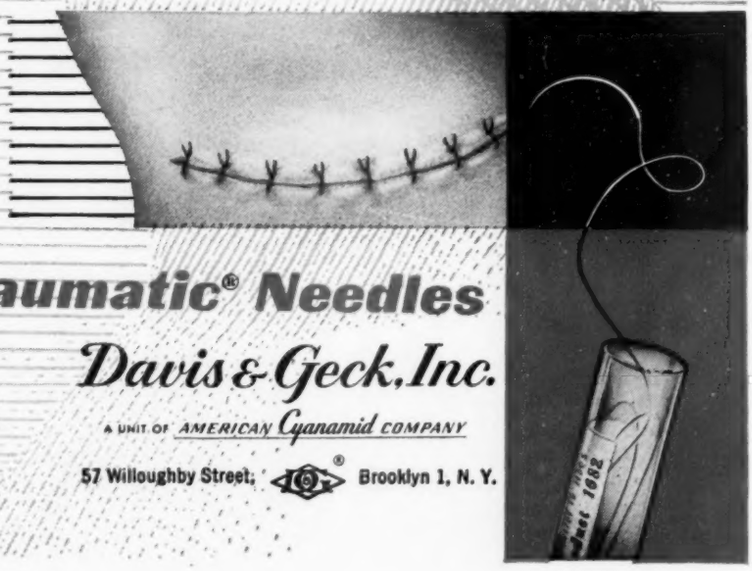
1682 is the D & G Dermalon® monofilament nylon suture with attached ATRAUMATIC® needle CE-4 (⅜ circle cutting point).

Dermalon nylon sutures . . .

- ▶ have the excellent tensile strength of nylon
- ▶ are easily removed, with little pain
- ▶ cause minimal tissue reaction
- ▶ have a distinctive blue color to make them easily discernible

Ask your suture nurse to have Davis & Geck's product number 1682 ready for all skin closures. Keep product 1682 in sizes 6-0 to 00 on hand for closing traumatic and minor surgery wounds at the office. D & G Atraumatic needles come to you in over 300 needle-suture combinations.

Product No. 1682 Dermalon suture with attached Atraumatic needle CE-4 (⅜ circle cutting point) Needle shown actual size ▼



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Davis & Geck, Inc.

A UNIT OF AMERICAN Cyanamid COMPANY

57 Willoughby Street, Brooklyn 1, N. Y.

Stop bleeding

from broad capillary bed . . .

Adrenosem (adrenochrome semicarbazone sodium salicylate), a synthetic complex, is a unique systemic hemostat, administered orally or parenterally.

It will not raise blood pressure nor affect cardiac rate or volume. It does not affect blood components associated with clot formation.

Adrenosem has such a high index of therapeutic safety that there are no contraindications in the recommended dose. Case histories attest its value as a hemostat in surgery and in pathologies characterized by hemorrhagic tendencies.*

*Sherber, D., Am. J. Surg., Sept. 1953

U. S. Pat. 2,581,850—1952

Adrenosem

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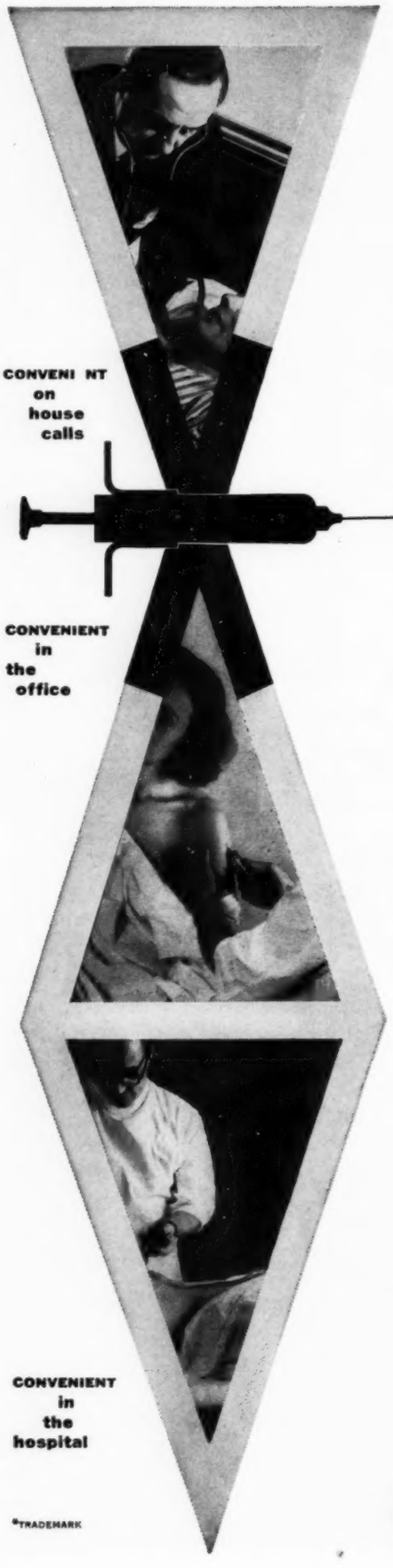

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It's the convenience of the PFIZER unbreakable STERAJECT Syringe and the full line of STERAJECT single-dose disposable cartridges that make this Pfizer innovation a favorite in office, home and hospital today. The current formulations of widely used antibiotics and hormones include the following ready-for-use cartridges, each with sterile foil-wrapped needle:

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Permapen *Fortified* Aqueous Suspension (300,000 units DBED penicillin plus 300,000 units procaine penicillin)

Combiotic® Aqueous Suspension (400,000 units procaine penicillin plus 0.5 Gm. dihydrostreptomycin)

Streptomycin Sulfate Solution (1 Gm.)

Dihydrostreptomycin Sulfate Solution (1 Gm.)

NOW ***Pfizer Syntex Steroids in Steraject form:***

Synandrol*—testosterone propionate, U.S.P., in sesame oil (25 mg., 50 mg., and 100 mg.)

Diogyn*—estradiol, U.S.P., in aqueous suspension (0.25 mg. and 1.0 mg.)

Syngesterone*—progesterone, U.S.P., in sesame oil (10 mg., 25 mg., 50 mg. and 100 mg.)

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PFIZER LABORATORIES, BROOKLYN 6, N.Y.
DIVISION, CHAS. PFIZER & CO., INC.

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Vitamins alone are not always enough

Based on the well recognized concept of interrelationship in nutrition, "Clusivol" Capsules offer an extensive formulation of vitamins, minerals, and trace elements . . . factors likely to be lacking when restrictive diets are prescribed.

Multiple vitamin-mineral supplement

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Vitamin A (synthetic)	25,000	U.S.P. Units
Vitamin D (irradiated ergosterol)	2,000	U.S.P. Units
Vitamin C (ascorbic acid)	150.0	mg.
Thiamine HCl (B_1)	10.0	mg.
Riboflavin (B_2)	5.0	mg.
Pyridoxine HCl (B_6)	1.0	mg.
Panthenol, equivalent to of calcium pantothenate	10.0	mg.
Vitamin B_{12} U.S.P. (crystalline)	2.0	mcg.
Folic acid	2.0	mg.
Nicotinamide	100.0	mg.
Vitamin E (as mixed tocopherols natural)	10.0	mg.
Inositol	30.0	mg.
Choline—from choline bitartrate	30.0	mg.
Biotin	0.1	mg.
d-Methionine	20.0	mg.
Cobalt—from cobalt sulfate	0.1	mg.
Copper—from copper sulfate	1.0	mg.
Fluorine—from calcium fluoride	0.025	mg.
Iron—from 4 gr. ferrous sulfate exsic.	76.2	mg.
Calcium—from dicalcium phosphate	165.0	mg.
Manganese—from manganous sulfate	1.0	mg.
Iodine—from potassium iodide	0.15	mg.
Molybdenum—from sodium molybdate	0.2	mg.
Potassium—from potassium sulfate	5.0	mg.
Zinc—from zinc sulfate	1.2	mg.
Magnesium—from magnesium sulfate	6.0	mg.
Phosphorus—from dicalcium phosphate	127.4	mg.

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about 'Ilotycin'

(ERYTHROMYCIN, LILLY)

Q. What is the status of 'Ilotycin' in the treatment of pneumonia?

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Q. Is 'Ilotycin' effective in urinary tract infections?

Yes, when the causative organism is susceptible to its action and when there is a minimum of mechanical factors, such as strictures, stone, and the like.

Q. How long should a streptococcus throat infection be treated with 'Ilotycin'?

The recommended minimum course for any antibiotic is five days. 'Ilotycin' completely eradicates the organisms within five days and thereby prevents recurrence of the infection.

Q. Is there any contraindication to the use of 'Ilotycin' immediately following a parenteral dose of penicillin?

No. 'Ilotycin' does not inhibit the activity of penicillin. There is probably no specific indication for using penicillin in addition to 'Ilotycin.' Experiments both in vitro and with animals have shown no evidence that 'Ilotycin' is either antagonistic to or synergistic with penicillin or the "mycins."

Q. Are coliform bacteria less sensitive to 'Ilotycin' than to other "broad-spectrum" antibiotics?

Yes. There is less possibility of monilia and fungus overgrowth in the intestinal tract with 'Ilotycin,' since the predominant organisms of the normal intestinal flora are relatively insensitive to the antibiotic action of 'Ilotycin.'

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Lilly THE ORIGINATOR OF ERYTHROMYCIN

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Editorial

FUNDAMENTALS OF WOUND HEALING

"IF you cut well and sew well your patient will get well." This is an ancient aphorism and, like most of the other aphorisms with which medical literature is so replete, it contains a great truth in a few words. Such a remark carries with it certain self-evident demands. It requires that anyone who contemplates performing an operation must be skilled in the art of surgery. He must know how to cut, when to cut and where to cut. In discussing the healing of wounds we are particularly concerned with how and where to cut. When to cut also plays a role in the healing process only slightly subordinate to the other two.

Let us first consider "how to cut." If you were trying to injure an enemy, would you select a sharp instrument or a dull instrument? Would you shoot him with a steel bullet or a lead nose bullet? Naturally, in the first instance, you would use a dull weapon which would cause a lacerated wound and, in the second instance, a lead nose bullet because it would flatten out and tear large areas of flesh. Lacerated wounds are associated with destruction and injury of large areas of tissue and are more prone to become infected than incised wounds. Therefore, an incised wound with its symmetric edges is the ideal wound. Wounds made by a surgeon should at all times be incised wounds. There is no condition in surgery which calls for the production of a lacerated wound or a contused one. It is sometimes necessary to perform a punctured wound such as when doing a paracentesis or a biopsy, or to make an abrased wound when removing skin for a skin graft, but a lacerated wound is never indicated. Frequently, a surgeon with a simple performance of a débridement will transform a lacerated wound into an incised one. All surgeons should constantly be on guard against creating a lacerated wound from an incised one. This is done by rough handling of tissue, i.e., the use of dull instruments; the use of big clamps; the unnecessary clamping of all blood vessels; the use of rough dry sponges; the constant sponging of the wound when suction would remove all blood clots; the cutting of tissue with scissors when a scalpel could be used.

To cut with a scissors requires crushing, and this causes unnecessary destruction of cells. Scissors can sometimes be used to cut fascia, pleura, peritoneum, or other membranes, but even here they should be used by approximating the blades and pushing them along a plane rather than closing the blades. Scissors should never be used to cut skin. Under all circumstances sharp dissection is better than blunt dissection, except in a few rare instances in which it is impossible or not feasible such as the dissection of subcutaneous or areolar tissue. It is almost impossible to make an incised wound with a pair of scissors. Errors in technic are often performed when it is found necessary to enlarge a wound, for it is here that the surgeon in his haste will use the scissors instead of the scalpel.

The use of large clamps with wide edges and cross striations, and worst of all, big teeth, is to be frowned upon. In many hospitals they

are no longer placed on the operative tray. Sometimes when grasping the cervix or a similar structure, it may be necessary to use such a clamp but, fortunately, its use is rapidly passing. The large curved Kelly clamp is still widely used but this also causes unnecessary destruction of tissue. Clamps can sometimes be too small and will pull off with tearing and have to be reapplied, causing additional trauma to the wound. The ideal clamp is the small hemostat commonly used in all hospitals. This is sturdy enough to hold firmly to the tissues and causes a minimum amount of crushing of tissue. The ideal way to suture a wound is not to grasp it with clamps at all; or when this is not mechanically possible, the best procedure is to use the smallest clamp available. Even in the clamping of large blood vessels the larger clamps are not necessary. These vessels should be elevated, ligated at two points, and then severed between the two ligatures. The small hemostats are large enough to grasp all smaller vessels.

The great inhibitions to perfect wound healing are dead and devitalized tissue and foreign bodies in the form of blood clots and excessive ligatures and suture material. When the mouth of the small vessels is grasped, a small bite should be taken and the ligature applied as close to the end as possible so that only a small cuff of strangulated tissue is left. If for any reason a long cuff is left, this should be cut off as near to the ligature as is safe. Under no circumstances should a ligature bind tissue other than a blood vessel. The ligatures should be just tight enough to approximate the mouth of the blood vessel and just loose enough not to strangulate it. The fallacy of mass ligature of tissue has long been known. This is frequently followed by bleeding or necrosis of a large number of cells followed by sloughing and often infection. The ideal method of controlling bleeding is by gentle pressure, and practically all capillary bleeding can be controlled by this procedure. Mont Reed, in one of his excellent articles on wound healing, made the following statement: "There can be no question that a blood clot in a wound interferes by tension with blood supply, prolongs wound healing, injects the presence of a large foreign body, and immeasurably encourages the development of infection and suppuration. Yet the excessive devitalization of living tissue by unnecessary ligatures of small blood vessels and too many tight sutures also interferes with blood supply, prolongs wound healing and invites infection." The ideal wound is one in which there is no foreign body, a minimum of dead cells and devitalized tissue, and just enough blood clot to hold the severed edges firmly together. This ideal should be sought by every surgeon, but I am sorry to say that not all surgeons keep it constantly in mind, and even men of some surgical repute violate this principle time and time again.

Suture Material. Some surgeons apply the principles of sewing a baseball cover to the sewing of living tissues. They use the largest suture available and pull it as tight as possible. These are the surgeons who have the largest number of wound disruptions, according to hospital statistics. Fortunately, their number is becoming less and less, for the principles of gentle handling of tissue, first advocated by Paré, and many years later by Halstead and his pupil, Mont Reed, have at long last taken deep root and are now bearing a rich harvest. The larger the suture or ligature, the more inflammatory reaction it will cause and the more apt it is to be pulled too tightly and thus cut off the blood supply to the wound edges. However, regardless of the character or caliber all suture material is a foreign body and as small amount as possible should be used in any wound. Nowadays the most common sutures used are catgut, silk, cotton and steel wire. Those made from kangaroo tendons and fascia lata strips are seldom used.

Catgut is almost a universal favorite in the United States, and the manufacturers of this product are constantly experimenting to improve it. Every two years these companies issue a brochure which explains their latest findings regarding their product, and they have been in the forefront in advocating the use of the smaller sizes of their material for both ligatures and sutures. They have standardized the sizes and tensile strength of the various strands and pack their product in glass tubes under the most aseptic conditions. We cannot recall any wound disruptions we have handled that could be directly attributed to faulty catgut. This complication can be caused not only by the size of the suture or ligature, but often is also due to the excessive amounts placed in a wound; that is, by ligating too many bleeding points which could be controlled by gentle pressure, tying too many knots, using double

strands of suture and leaving excessively long ends.

Cotton is less apt to cause trouble than silk because it is a vegetable fiber and is twisted instead of spun, thus reducing its capillary attraction. It has the great advantage of being readily available at all times and is much cheaper than catgut. Like silk it cannot be used as a running stitch except in the skin for it has little elasticity and is apt to break. Its use is improved if it is oiled or greased with bone wax, as this causes the fibers to lay down and allows it to be easily drawn through the tissues. Waxing also seals the fibers and reduces their capillary attraction, thus lessening the chance of infection. Its one disadvantage when placed in the skin is that of becoming stained and being difficult to find. This disadvantage has been overcome by some surgical houses by dying it; however, they have also increased the price of this colored product.

Some men who like silk are fanatic advocates of it, and quick to defend its use with the statement that if it is used properly in a non-contaminated wound, the formation of abscesses will not occur. However, like most things in medicine, the nearer a technic is to being "fool proof" the better it is for general use. Silk, in particular, causes an excessive pooling of serum about it by capillary attraction with subsequent infection. This suture is now braided to reduce its capillary attraction and this has lessened the chance of a stitch abscess. Under most circumstances small size catgut is to be preferred to either silk or cotton because it is rapidly absorbed and after a short period of time is completely removed from the vicinity of the wound. Silk or cotton placed deep in a wound are not absorbed and are frequently extruded through the skin by the formation of abscesses and sinuses.

Stainless steel wire or braided tantalum is advocated by some competent surgeons as a buried suture. Its only advantage as a buried suture is that steel is practically inert to tissue juices and can remain in place indefinitely. However, it has many disadvantages which militate against its use as a buried suture. It is stiff and hard to handle. It must be used as an interrupted suture. The knots must be carefully tied and twisted, and the ends cut very short. Patients sometimes complain that they feel the sharp edge of something under the skin. This requires a careful explanation of what has been done but many patients are still skeptical. After its use in a herniorrhaphy I have known of cases in which the wire migrated along the fascial planes from the inguinal region to the thigh. In contradistinction to its shortcomings as a buried suture wire is close to the ideal suture material for skin closure. It can be used as either a running or interrupted stitch, and in contaminated wounds it will not cause a stitch abscess even when left in place for an indefinite period. It has only two disadvantages as a skin stitch: (1) it is a little hard to handle and is apt to kink; (2) it has a tendency to bury itself and, therefore, may be difficult to remove.

In selecting any suture material it is always well to remember that its tensile strength need never be any greater than the tensile strength of the tissue in which it is placed. If it is greater, it will soon cut through the tissue which it binds.

Infection in Wounds. How many of us stop to think why it is that an open wound almost invariably remains free from infection, even when it is grossly contaminated? The reason is that the body fluids, blood and serum, flush the wound of dead and necrotic material, and at the same time make the environment undesirable for bacteria. It is only during this initial or exudative stage of wound healing that infection occurs. Sutures placed in a wound at this time prevent the flushing action of these tissue juices and encourages the production of bacteria. During the last war the Medical Advisors to the Armed Forces, who undoubtedly were men of vast surgical experience, issued a general order that all wounds should be left open until they could be properly repaired. Thousands of young lives were saved because of this order.

Sutures are man's invention, and in placing them he is merely trying to enhance and hasten the reparative stage before the wound is actually ready. He can safely and successfully do this if he first frees the wound of all harmful foreign material in the form of dead cells and bacteria which thrive on them. No single bacterium is capable of destroying a living vital cell and I am sure that a pure culture of staphylococcus could be poured into an open wound without infecting it, provided no dead or devitalized cells were present and the wound was not immediately approximated with a suture. I am not advocating the disuse of sutures, but I am trying to show that man in

using them often interferes with the natural inherent forces of resistance to infection that the body possesses.

Prevention of Infection. Any physician would be aghast if he walked into an operating room today and saw a patient's abdomen opened without first having been thoroughly prepared and a mild antiseptic applied. The use of strong antiseptics on the skin for the purpose of sterilizing it is a great error, for any antiseptic that is capable of killing bacteria is also capable of killing living cells along the wound edges. The use of strong antiseptics is particularly harmful in traumatic wounds, because they may devitalize cells which might have remained viable if the wound had been gently washed with soap and water and flushed with normal saline solution, and then approximated. The use of detergents has been a great step forward in asepsis of wounds.

It would be far better for all wounds if the principles of antisepsis were placed in the realm of discarded things, and the principles of asepsis were adhered to strictly. By this I mean that in preparing a wound, either elective or traumatic, the removal of bacteria should be aimed at rather than attempting to kill them with some antiseptic solution. The principle of asepsis in modern surgery far outweighs that of antisepsis, for the organisms carried into a wound by the hands and instruments of a surgeon are apt to be more harmful and virulent than those occurring there by accident. So modern surgery aims at removing all bacteria from the vicinity of a wound by strict sterility of all instruments and material entering it, and washing the wound thoroughly to remove all foreign material to which bacteria might cling.

Even with the best asepsis possible all wounds, elective or traumatic, have numerous organisms present, and it is in overcoming these that the sulfones and antibiotics play one of their greatest roles. All of us who were trained and practiced surgery before the advent of these drugs have been frequently amazed and constantly edified by their action. The mortality in some diseases, such as appendicitis, has dropped almost to nothing, and many other diseases are no longer the fearful plagues they once were. Contrary to what the layman might think, these drugs are not alone the cause of the lowered mortality in surgery during the past ten years. The seeds of gentleness in handling of tissues planted by Paré, cultured by Lister, watered by Halstead and many other great surgeons have grown into full flower and mankind is now benefiting by the years of accumulated knowledge of wound healing.

We do not advocate the use of the sulfones and antibiotics following all operative procedures, for they are not necessary after the ordinary elective operation of short duration, such as a herniorrhaphy or uncomplicated hysterectomy. Their administration may bring about a sensitivity to their use later on when the individual may need them. However, when any of the systems of the body are entered, such as the gastrointestinal, respiratory or urinary tracts, these drugs should always be administered preoperatively and postoperatively. The lone exception to this rule might be following an interval appendectomy. Many surgeons, even in these instances, do not think them necessary but it is probably safer to give them for a day or two.

In preparing the gastrointestinal tract for surgery none of the sulfones or antibiotics can replace cleanliness. Any part of the alimentary canal can be opened with impunity, if the mucous membrane is completely free of foreign material or excessive secretions, and the operation is done with gentleness and minimal cell destruction. As we have repeatedly stated nothing can replace or substitute for these factors. The antibiotics are also indicated after prolonged and massive surgical procedures of all types, and their use can be supplemented by the sulfones. The combination of these two drugs give a better antibacterial spectrum than when one is used alone and is a practice of proven worth.

All traumatic wounds, no matter how well they are cleaned or débrided, are highly contaminated with bacteria, and any physician who would not administer one of the sulfones or antibiotics to a patient suffering from such a wound would be remiss. If a severe infection develops the physician could properly be criticized and possibly held legally responsible for not adhering to the ordinary mode of treatment of his community.

Physiologic Rest. One of the important fundamentals of wound healing is physiologic rest. The immediate pain and stiffness to a part following injury is nature's attempt to put the part at rest. We are all familiar with what happens to an extremity following the fracture of a bone. The part becomes painful, swollen and

the muscles go into spasm in an attempt to hold the part at rest. The swelling will gradually subside and so will the acute pain, but the stiffness will not disappear until the bone is completely healed. In the application of a cast to such an injury we aid the natural forces in resting the part. As years go by we are understanding this function of rest better, and we no longer prolong it beyond the time required by nature to heal a part. I can remember the time when a Colles' fracture was held in a cast for six to eight weeks and when the forearm was removed, the wrist and fingers were so stiff that it took weeks to overcome it. Now we know that a short initial period of complete immobilization only is needed, and after this the part will heal better if it is quickly rehabilitated. The circulation to the part will improve with motion, the muscular tone will return and the healing will be hastened. These principles hold true not only for an extremity, but also for the entire mechanism. Early ambulation and feeding of patients following massive surgery is paying large dividends in rapid recovery with lowered mortality and physiologic, psychologic and financial benefits to the sick and injured.

Systemic Factors. In addition to those local factors which are important in wound healing there are certain general or systemic factors which merit consideration. Attention to the patient as a whole is necessary, in addition to care in the management of wounds.

The normal individual who incurs trauma or undergoes surgery experiences a reaction to such injury which involves the cardiovascular, nervous, renal and other systems to a varying degree. The healing of the wound is perhaps a more obvious manifestation of this reaction but may be of relative unimportance. It should be appreciated, however, that proper atraumatic, aseptic care of the wound plays a major role in the ultimate pattern of the reaction to injury.

Frequently, patients who are subjected to surgery are not normal as regards cardiac and renal function, or are nutritionally inadequate as a result of their disease. Too, endocrine imbalances may exist and alter their response to injury. Some of these abnormalities cannot be satisfactorily adjusted, and such patients are necessarily considered "poor operative risks." However, such conditions as anemia, hypoproteinemia, undernutrition and dehydration can often be corrected prior to surgery, with improvement in the patient's response to surgery.

It has been well demonstrated that patients with anemia and/or depleted body protein heal poorly. The physiologic process of wound healing requires healthy tissues. The preoperative use of blood transfusion and high caloric, high protein diet are indicated in patients who have significant anemia or whose nutrition is substandard. Elective surgery should be delayed in order to attend to these deficiencies. If surgery is urgent, postoperative transfusion and early restoration of diet may obviate difficulty.

The state of hydration, which implies not only body water but also the electrolyte composition of body fluids, is an important consideration in wound healing and response to surgery. Abnormal losses of water and/or electrolyte occur in a variety of conditions, both preoperatively and postoperatively. The body continually attempts to maintain an isotonic equilibrium of its fluid constituents. Recognition of fluid and electrolyte deficits and their correction preoperatively should be done whenever possible. The obtaining of a good history and careful examination of the patient usually enable fairly accurate estimate of these deficiencies. Laboratory data are adjunct to clinical appraisal, and should not, in most instances, be considered the sole guide to therapy.

Postoperatively, prevention of fluid and electrolyte deficiencies is the best treatment. Except for the more complicated cases, provision of sufficient water intake and of calories to allay ketosis are all that are required for two to four days. If the patient is unable to take nourishment orally, parenteral administration of glucose in water is used. It is an example of bodily economy that some electrolytes, notably sodium, are conserved during this period and need not be given. Other electrolytes, e.g., potassium, are not conserved but in a short period of time deficiency is unlikely. To avoid dehydration and electrolyte imbalance all patients should be examined frequently after operation and therapy begun when early signs of a deficiency are present. Subclinical vitamin deficiency, particularly vitamins A, B and C, is common and may affect the surgical patient unfavorably. Supplementary oral or parenteral administration of these vitamins may be advisable as an adjunct measure.

One must, therefore, keep in mind the important role that preoperative correction of

existing deficiencies and the prevention of development of such deficiencies after operation, play in wound healing. Proper attention to the care of the wound and to the physiologic mechanisms which are so closely related is rewarded by successful restoration of the patient to normal.

Because of modern refinements in technic and anesthesia, and because men are taken at an early age and trained in the art of surgery, each succeeding generation of surgeons are better in all phases of surgery. These surgeons know the role the antibiotics play in prevention of infection, but they also know that the living cell is still the greatest barrier to infection. They have the same respect for the single living cell as they have for the entire mechanism, be it asleep or awake. They know that unnecessary injury to one cell might be followed by death of the entire part.

PHILIP A. CAULFIELD, M.D. AND
HOWARD S. MADIGAN, M.D.

Original Articles

PANCREATIC CYSTS*

LAURENCE S. FALLIS, M.D. AND JAMES BARRON, M.D.
Detroit, Michigan

PANCREATIC cysts, like other disorders of the pancreas, are of relatively rare occurrence; therefore no one surgeon is in a position to consider the problem on the basis of his own personal experience. The collected observations of groups of surgeons working in large clinics are also meager, thus accounting for the great variation in the proposed methods of treatment and a certain disparity in results obtained. For example, Judd[1] reported only eighty-eight operated cysts of the pancreas in over 700,000 admissions to the Mayo Clinic, and Brilhart and Priestley[2] reported on only forty-four patients with pancreatic pseudocyst operated upon during the period 1935 to 1947, inclusively. Kunc[3] stated that up to 1940 there were only 500 case reports in the world literature. At the Henry Ford Hospial we have operated upon only twenty-one patients with pancreatic cysts of a total of approximately 650,000 hospital registrations.

CLASSIFICATIONS

Many classifications of pancreatic cysts have been made, all of which have contributed to our knowledge of the condition, even though it has been stated that a discussion of the etiologic factors and attempts at classification are only of academic interest since the treatment is always operative. At the same time it must be agreed that at least an outline is essential for a detailed consideration of the subject. Basically there are two types of cysts, the true and the false. Theoretically, a true cyst should have a complete epithelial lining, but from pressure or inflammatory reaction the epithelium may be lost so that at the time of operation it may be difficult or even impossible to classify the cyst. Moreover, the presence of all three pancreatic ferments does not prove that the cyst was of pancreatic origin, and conversely, the absence of pancreatic ferments does not negative the suggestion that the cyst is of pancreatic origin.

TRUE CYSTS

I. Congenital
   1. Solitary cyst
   2. Dermoid or inclusion cyst
   3. Multilocular cystic disease
II. Retention: secondary to
   1. Inflammation
   2. Calculus
   3. New growth
III. Degenerative
   1. Cystadenoma
   2. Cystadenocarcinoma
   3. Sarcoma
IV. Parasitic
   1. Hydatid

FALSE CYSTS

I. Traumatic
II. Inflammatory

True Cysts

True cysts are those cysts which have an epithelial lining derived from the ductal or acinar structures or are developed entirely within a solid tumor arising therefrom.

Congenital Cysts. The most common congenital cyst is found in infancy and is considered to be due to defective development. Its location in the tail or body of the pancreas renders it amenable to surgical excision. Dermoid and inclusion cysts have similar characteristics. Multilocular cystic disease of the pancreas is of passing interest only in that it is often associated with the same condition in the kidney and less frequently in the liver.

* From the Department of Surgery, Henry Ford Hospital, Detroit, Mich.

Retention Cysts. Complete blocking of the external secretory apparatus of the pancreas in experimental animals results in atrophy of the gland. However, gradual compression of the main ducts, such as occurs in chronic, recurring, relapsing pancreatitis and secondary to pancreatic calculi, and neoplasms involving the head of the pancreas, result in gradual dilatation of the ductal and acinar system to the point that definite cysts may be observed. These cysts seldom attain any great size and require treatment only as incidental to the condition which causes them. However, in certain instances large cysts do develop, the origin of which has been attributed to retention, although the rationale of this etiologic concept may be challenged. Whatever the cause these cysts usually contain all the external secretory ferments of the pancreas and are enclosed in a thin wall which is lined by epithelium. These large cysts may be confused with pseudocysts and, as mentioned in the foregoing differentiation, may be exceedingly difficult, especially in those cases in which atrophy of epithelial lining has occurred. It is important to distinguish between these two types from the point of view of treatment for the thin-walled epithelial-bred cyst often lends itself to complete removal while the pseudocyst usually is best treated by marsupialization.

Degenerative Cysts. These are cystic spaces which develop in degenerating new growths. The locules are numerous and vary in size from microscopic to several centimeters in diameter. The cut surface of the tumor presents a honeycomb or sponge-like appearance. The supporting stroma varies in amount. The cyst spaces are filled with a mucous fluid of variable viscidity and sometimes have papillary projections. The tense semi-translucent capsule contains a well delineated network of arteries and veins and occasionally is the seat of calcium deposit. Both benign cystadenoma and cystadenocarcinoma have been reported. Degeneration also occurs in sarcoma and teratoma of the pancreas.

Parasitic Cysts. Hydatid cysts of the pancreas are the only type of parasitic cyst seen and these are rarely encountered in non-tropical countries.

False Cysts

Pseudocysts or false cysts of the pancreas are the most common cysts of the pancreas that come to the attention of the surgeon. These false cysts have two main sources or origin: traumatic and inflammatory. They have no epithelial lining and usually are found in the lesser peritoneal cavity. The foramen of Winslow, surrounded as it is by loose connective tissue, becomes completely obliterated following trauma or inflammation in the pancreas. The wall of the cyst is formed posteriorly by the body and tail of the pancreas with its peritoneal covering, anterosuperiorly by the lesser omental structures and antero-inferiorly by the posterior wall of the stomach and the gastrocolic omentum and the transverse colon with its mesocolon. There are therefore three possible avenues of approach to the cyst contents, through the lesser omentum, the gastrocolic omentum or the mesocolon. Accumulations in the area occasionally travel to the left between the layers of the mesocolon and present in the region of the splenic flexure, often producing diagnostic problems. Rarely, the fluid collection extrudes downward behind the posterior parietal peritoneum and appears in the lower left quadrant of the abdomen.

Cyst Contents. The cyst contents vary widely according to whether they are due to injury or acute pancreatitis. Primarily the fluid accumulation consists of pancreatic secretion mixed with blood modified by the amount of the product of pancreatic disruption whether produced by trauma or autodigestion. Thus the contents may be clear, blood-stained, mucoid, or rendered turbid by cholesterol, fragments of pancreatic tissue, areas of fat necrosis, etc. If the fluid collection becomes infected early, a pancreatic abscess develops. Infection manifests itself by fever, chills, etc., and a rapid increase in the size of the mass. The slowly enlarging pseudocyst is unlikely to be infected.

Traumatic Pseudocyst. Pseudocysts follow both indirect and direct trauma.

Indirect trauma: The pancreas lying as it does at right angles to the unyielding vertebral column and not protected by a true enveloping capsule is practically vulnerable to trauma exerted directly upon the upper and mid-abdominal wall. The force required to injure the pancreas varies from a single severe direct injury to the abdominal wall to repeated slight blows. The exact mechanism of the injury has been described as being due to recoil such as occurs in "contre coup" injuries

to the brain. Wangensteen reports a case resulting from the kick of a horse. Early published reports of pseudocysts attributed a traumatic origin in about 20 per cent of the cases but in later series a figure of 10 per cent is quoted. The decrease in traumatic pseudocysts is coincidental with the advent of the motor age. Run-over accidents of the horse and buggy age were a frequent etiologic factor. Boys "hitching" rides on light delivery wagons frequently missed their footing and fell in such a fashion as to be run over by a wheel. Recovery from the injury was usually prompt and the swelling in the upper abdomen due to the cyst did not manifest itself until weeks or sometimes months had passed.

Direct trauma: Pseudocysts develop also following direct trauma to the pancreas such as occurs during gastric resection when the gastric lesion is adherent to the pancreas and when the tail of the pancreas is injured during splenectomy. Certain operations on the pancreas itself are complicated by the subsequent development of pseudocysts. Partial pancreatectomy, biopsy of pancreatic lesion and removal of pancreatic calculi have all contributed examples of this condition. Pseudocysts after operation develop from two sources, either primarily from injury to the main ductal system or secondarily to the acute pancreatitis which not uncommonly complicates direct attack on the gland. Another example of direct trauma is that produced by a foreign body as illustrated by the following example:

A forty-eight year old white man was admitted to the Henry Ford Hospital for the treatment of a gradually increasing swelling in the upper abdomen. A history of an attack of acute pancreatitis treated at another hospital three months previously was obtained. The diagnosis had been made at laparotomy during the acute episode. Penrose tube drainage of the lesser peritoneal sac was the only surgical treatment performed. The drains were removed at the end of a week and healing was complete shortly thereafter. The patient's general condition did not improve. There had been progressive weight loss with gradually increasing distention of the upper abdomen. A diagnosis of pancreatic cyst was made on the basis of the history. At reoperation a large cystic cavity containing a gauze sponge was encountered. Removal of the sponge and marsupialization of the cyst resulted in recovery.

Inflammatory Cysts. Pseudocysts develop in some patients following attacks of acute pancreatitis. The lesser peritoneal sac becomes isolated from the general peritoneal cavity by obliteration of the foramen of Winslow by edema. The abundant blood-stained exudate composed of pancreatic secretion and the other products of pancreatic disruption gradually increase in size until the patient's attention or that of his medical attendant is directed to it. In many instances the attack of acute pancreatitis was undiagnosed either because of mildness of symptoms or because the physician was unfamiliar with the clinical manifestations of the disease. Infection of the cyst contents when it supervenes produces an abscess. These cysts usually are readily diagnosed when they point above or below the stomach; but when they present between the leaves of the mesocolon or below it, they present diagnostic problems which often are not settled except at operation.

Clinical Feature. The appearance of a mass in the upper abdomen with the history of antecedent injury or of an attack of acute upper abdominal pain, characteristic of acute pancreatitis, strongly suggests a diagnosis of pancreatic cyst. Upper abdominal pain radiating through to the back is a constant symptom. Bloating, indigestion and loss of appetite contribute to the weight loss which is nearly always present. Excessive weight loss of over 90 pounds such as occurred in one of our patients may lead to an erroneous diagnosis of malignancy. Coexistent biliary tract disease is present in fully 75.0 per cent of the patients. The diagnosis is made by excluding other lesions in the upper gastrointestinal tract. A cystic enlargement in the head of the pancreas produces widening of the duodenal curve. Large pseudocysts show pressure defects on the greater or lesser curvature of the stomach, depending on whether they present above or below the stomach. In the differential diagnosis carcinoma of the stomach, hydrops of the gallbladder, hydronephrosis, liver tumor and retroperitoneal cysts and tumors have to be considered. The chief difficulty lies with some of the smaller cysts when definite diagnosis is made only at the operating table. Mild diabetes is found in about 5.0 per cent of patients with pancreatic cysts just as it occurs as a sequela of acute or chronic pancreatitis.

TREATMENT

Operation is mandatory for all cysts of the pancreas. Surgical intervention is of four types: (1) aspiration, (2) excision, (3) external drainage marsupialization and (4) internal drainage —enteroanastomosis.

Aspiration. This should be the method of treatment employed in instances in which the cyst is a relatively small one and does not lend itself to excision or marsupialization. It is not a recommended form of therapy but occasionally will yield a satisfactory result, as the following case history indicates:

A sixty-three year old physician was admitted for the diagnosis and treatment of intermittent jaundice. Gastrointestinal x-ray series revealed a large duodenal sweep suggesting enlargement of the leaves of the pancreas. At operation a cyst of the head of the pancreas was found. Removal of the cyst was impossible owing to the anastomotic structures involved, and the cyst was not of sufficient size to permit marsupialization. Simple aspiration of the cyst resulted in apparent cure of the condition, for the patient has remained entirely well during the subsequent eight years.

Excision. This is the operation of choice, but unfortunately is applicable in only a limited number of instances such as in solitary or degenerative cysts occupying the body or the tail of the pancreas. In these cases partial pancreatectomy can be performed without compromising important structures, or more rarely the cyst can be dissected away from adherent adjacent structures. The mortality is high following complete excision and especially in those cases in which excision has been attempted inadvisably and the operation subsequently has been abandoned. It is recommended, therefore, only for those cases in which partial removal of the pancreas can be effected with ease.

Marsupialization. This method of treatment of large pancreatic cysts, while not ideal, is a thoroughly satisfactory surgical procedure. It has the great advantage of being applicable even in the presence of infection. Complications are rare and failures often may be attributed to inadequate operation. The principle of marsupialization is an old one and implies suture of the incised margins of the cyst to the skin of the abdominal wall. It is not simple drainage of the cyst regardless of the number of drains employed. The procedure is carried out as follows: The abdominal cavity is entered over the dome of the cyst, preferably by a transverse incision through all the layers. The cyst wall is then incised transversely. The contents are evacuated and all loculi are converted into one cavity. The margins of the incised cystic wall are now sutured to the skin of the abdominal wall over as large an area as can be managed, a procedure that may require some mobilization of the cyst. The resulting opening should be 4 inches long at least. The cystic cavity is then firmly packed with a 4 inch gauze roll saturated in petrolatum or dichloramine-T solution, using special care to keep the margins of the wound well separated. The gauze pack should not be disturbed for at least a week unless there is clinical evidence that infection is accumulating. Removal is not begun before the seventh postoperative day and is gradually completed in a week or ten days. The patient leaves the hospital with a wide open sinus tract which tends to fill in rapidly at first, but more slowly as time goes on. Complete obliteration of the cavity may be accentuated by injection of sclerosing solution such as sodium morrhuate. Final healing will take place usually in from three to six months. Recurrences are not common when the cyst margins are sutured to the skin and the cyst is well packed. These two points require emphasis for it is on them that the success of marsupialization depends. The completeness of resolution of the cystic cavity is amazing. At operation for repair of postoperative ventral hernia two years after marsupialization of a pancreatic pseudocyst resolution of the cystic cavity was found to be complete. No evidence of the cyst remained other than a few filmy adhesions of the omentum to the anteroabdominal wall and the characteristic persistent induration and enlargement of the pancreas.

Enteroanastomosis. Various authorities, notably Lahey[4] and Chapman,[5] have experienced dissatisfaction with the results of marsupialization. They have proposed and carried out internal drainage by anastomosis of the cyst to the stomach, duodenum, jejunum, colon and even the gallbladder. The initial results appear to be quite satisfactory. Advantages claimed are greater certainty of cure and shorter convalescence. It is a practical method of dealing with a moderate-sized cyst unsuitable for excision and not of sufficient size to permit suture of its margin to the skin of the abdominal wound. The theoretic disadvantage of acti-

vating pancreatic ferments by bile has not been recorded in practice. Nevertheless, on theoretic grounds alone it would appear to be preferable to utilize the jejunum rather than the stomach or gallbladder for the anastomosis. The successful employment of the Roux-Y principle in total gastrectomy and in stricture of the common bile duct suggests its use here. The authors have had no practical experience with enteroanastomosis in the treatment of pancreatic cysts.

SUMMARY AND CONCLUSIONS

1. Pancreatic cysts are rare tumors.
2. Differentiation between true and false cysts often is difficult.
3. The treatment of all cysts is operative.
4. The ideal treatment of excision of the cyst has limited application.
5. Marsupialization is a satisfactory method provided that it is carried out properly.
6. Every cyst wall should be biopsied to exclude malignancy.

REFERENCES

1. Judd, E. S., Mattson, H. and Mahorner, H. R. Pancreatic cysts; report of 47 cases. *Arch. Surg.*, 22: 838–849, 1931.
2. Brilhart, K. B. and Priestley, J. T. Pseudocysts of the pancreas. *Am. J. Surg.*, 81: 151–160, 1951.
3. Kunc, Z. Direct anastomosis between pancreatic cyst and intestinal tract. *J. Internat. Coll. Surgeons*, 10: 529–540, 1947.
4. Lahey, F. H. and Lium, R. Cure of pancreatic fistula by pancreatojejunostomy; report of case with review of literature, *Surg., Gynec. & Obst.*, 64: 79–88, 1937.
5. Chapman, C. L. G. Pancreatic cyst treated by implantation into the jejunum. *Brit. J. Surg.*, 28: 633–634, 1941.
6. Scott, J. V. Pancreatic cyst. *Arch. Surg.*, 59: 1304–1318, 1949.
7. Adams, R. and Nishijima, R. A. Surgical treatment of pancreatic cysts. *Surg., Gynec. & Obst.*, 83: 181–187, 1946.
8. Meyer, K. A., Sheridan, A. I. and Murphy, R. F. Pseudocysts of the pancreas; report of 31 cases. *Surg., Gynec. & Obst.*, 88: 219–229, 1949.
9. Chesterman, J. T. Treatment of pancreatic cysts. *Brit. J. Surg.*, 30: 234–235, 1943.

ANNULAR PANCREAS*

A. J. Tomsykoski, M. D., Richard C. Stevens, M.D. and Patrick A. Izzo, M.D.
Binghamton, New York

ANNULAR pancreas was described by Ecker[1] in 1862 as "a strip of glandular substance which lay across the descending portion of the duodenum." Gross[2] in a review of the literature was able to collect fifty cases, thirty-nine of which were incidental to findings at necropsy; eleven of the fifty subjects had complaints which led to clinical study and eventual surgery. Case reports of surgically treated patients became more numerous and Silvis[3] was able to collect twenty-six such cases. Since that time an additional six cases[4–6] have been added to the literature.

EMBRYOLOGY AND ETIOLOGY

Two out-pocketings from the entodermal lining of the gut represent the earliest indications of the future pancreas. These buds arise on opposite sides of the duodenum in 3 to 4 mm. embryos. One pushes out from the dorsal wall just cephalad to the level of the hepatic diverticulum and this becomes the dorsal pancreas. The other, probably originally paired, appears ventrally in the caudal appendage between the gut and the hepatic diverticulum and consequently is designated the ventral pancreas. Of the two pancreata the dorsal one grows more rapidly. In the sixth week it is an elongated, nodular structure with a centrally coursing duct which extends into the dorsal mesentery and, arising near the mouth of the developing omental bursa, continues its growth within the dorsal layer of the sac. The ventral pancreatic bud remains smaller and its duct is promptly carried away from the duodenum by the lengthening common bile duct; it then arises from the latter. Unequal growth of the duodenal mass shifts the bile duct dorsad and brings the ventral pancreas into the dorsal mesentery near the stem of the dorsal pancreas. During the seventh week the two interlock intimately to form the adult-shaped pancreas. Grossly, the dorsal pancreas forms all of the adult gland except the head which comes primarily from the ventral primordium.[7] Most workers believe that the malformation results from the failure of the ventral pancreatic anlage to rotate with the duodenum as does its outlet. Hence a band of pancreatic tissue becomes wrapped around the duodenum, the duct of which sweeps around the entire duodenum to enter the duct of Wirsung.

DIAGNOSIS

This anomaly should be suspected especially in newborn infants who present the typical symptoms of duodenal obstruction, namely, persistent vomiting, upper abdominal distention, visible peristaltic waves, decrease in size and frequency of meconium stools, progressive weight loss, dehydration and in some cases jaundice. The roentgenographic picture is the "double-bubble" sign produced by the dilated and radiolucent stomach and proximal dilated segment of duodenum. Shapiro et al.[6] reviewed the five cases reported in the literature and added four cases of annular pancreas occurring in the neonatal period. It was their conclusion that the findings in all cases were findings common to all duodenal obstruction regardless of etiology.

In adults the diagnosis is difficult to make, mainly because of the rarity of the disease. The onset of symptoms may be in any age group and the findings are those of chronic duodenal obstruction with epigastric pain, indigestion, nausea, vomiting, and in one case[5] jaundice. A correct preoperative diagnosis was first made by Lehman[8] who suggested that diagnosis may be possible at times in the presence of chronic duodenal ileus supplemented by roentgenographic evidence of obstruction which also reveals a smooth niche constricting the second portion of the duodenum from its dextral aspect. A correct diagnosis has been made in two cases[9] and entertained in several others since his description. In our case the roentgen diagnosis was duodenal diverticulum and the pattern described by

* From the Binghamton City Hospital, Binghamton, N. Y.

Lehman was not seen when the films were reviewed postoperatively.

TREATMENT

In review of the surgically treated cases (Table 1) it appears that some short-circuiting type of operation would be the procedure of choice as opposed to either resection or division of the anomalous pancreatic ring. The most satisfactory results have been obtained with duodenojejunostomy although an adequate evaluation of the different by-pass operations is not available since the cases are too few in number. An additional factor which must be considered is that many of the patients were operated upon before the present day advances

TABLE 1

Type of Operation	Author	Sex and Age of Patient	Results	Remarks
Resection of pancreatic ring	Lerat[19]	F, 46 yr.	Cured	Drainage ceased on 13th day
	Lehman[8]	M, 23 yr.	Recovered	Symptoms persisted
	Goldyne[20]	M, 26 yr.	Cured	Partial resection of ring
	Burger[21]	F, 4 days	Died	Partial resection of ring
	Ravitch[14]	M, 57 yr.	Recovered	Recurrence of symptoms; Heineke-Mikulicz operation on duodenum; gastrojejunostomy 37 days later
	Haden[22]	M, 3½ yr.	Cured	Partial resection of ring
	Silvis[3]	M, 37 yr.	Cured	Partial resection of ring
	Wakely[4]	M, 36 yr.	Cured	Partial resection of ring
	Payne[9]	M, 33 yr.	Recovered	Persistence of duodenal obstruction
	Anderson[5]	F, 32 yr.	Recovered	History of jaundice; persistence of common duct obstruction
Division of ring	Howard[15]	F, 46 yr.	Cured	Pancreatic fistula requiring another operation
	Zech[16]	F, 27 yr.	Cured	Heineke-Mikulicz operation on duodenum; small pancreatic fistula
	Brown[17]	F, 53 yr.	Died	Duodenostomy; duodenal fistula
	Conroy[18]	M, 30 yr.	Cured	
Posterior gastroenterostomy	Vidal[23]	M, 5 days	Cured	Congenital atresia of duodenum present
	dos Santos[24]	F, 26 yr.	Died	Pneumonia; chronic interstitial pancreatitis
	Smetana[25]	M, 74 yr.	Died	Marked pancreatic fibrosis; carcinoma of cystic duct
	Brines[26]	M, 44 yr.	Died	Respiratory infection
	Truelson[27]	M, 35 yr.	Cured	Plastic on duodenum also
	Conroy[18]	F, 26 yr.	Cured	
Duodenojejunostomy	Gross[2]	F, 3 days	Cured	
	Ravitch[14]	M, 57 yr.	Cured	Duodenojejunostomy after first operation; symptoms and obstruction recurred
	Ravitch[14]	F, 3 days	Cured	
	Shapiro[6]	F, 7 days	Cured	Duodenal atresia; constricting ring 1 cm. to right of ligament of Treitz
	Shapiro[6]	M, 17 days	Cured	Mongolism
Gastroduodenostomy	Ravitch[14]	M, 8 days	Cured	Malrotation of intestine; complete duodenal atresia; portal vein anterior to duodenum
	Shapiro[6]	F, 3 days	Cured	Duodenal atresia
Duodeno-duodenostomy	Shapiro[6]	M, 10 days	Died	Mongolism; incomplete rotation of colon; bronchial obstruction 11 days postoperatively
Partial gastric resection	Custer[10]	M, 74 yr.	Cured	Concomitant gastric ulcer; Balfour-Polya procedure
	Olmacher[11]	M, 39 yr.	Cured	Partial absence of pylorus
	Baker[12]	M, 27 yr.	Cured	Gastric ulcer present; duodenojejunostomy also done
	Cattell[13]	M, 33 yr.	Cured	Division of ring; concomitant duodenal ulcer; postoperative jejunal fistula; Roux exclusion and resection of fistula
	Tomsykoski	F, 50 yr.	Cured	Division of ring; Polya type resection and cholecystectomy
Drainage of pancreatitis	Brines[28]	M, 35 yr.	Died	

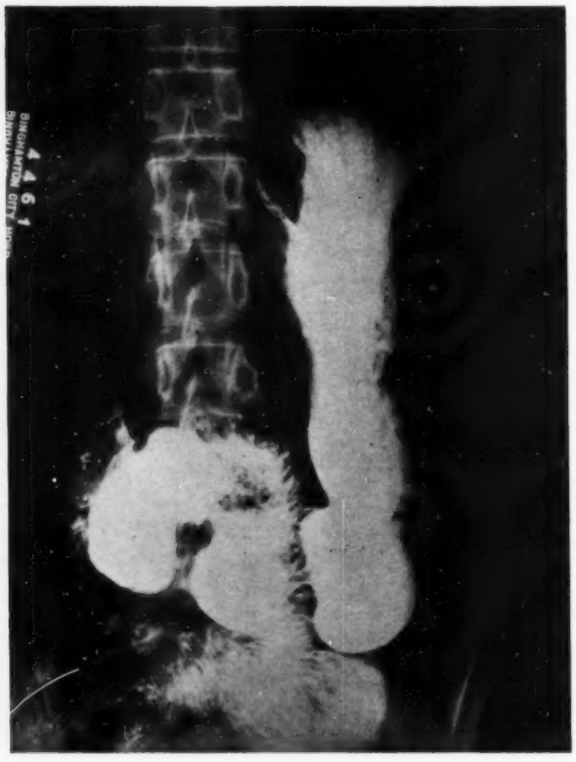

FIG. 1. Roentgenogram diagnosed as large duodenal diverticulum. Note the postbulbar deformity.

in surgery; hence there would necessarily be a difference in the morbidity and the mortality rates. The major contraindications to attack on the pancreatic ring are high incidence of recurrence of obstruction and the high frequency of pancreatic fistulas. Gastric resection may be contemplated in cases in which a gastric or duodenal ulceration is also present. Five gastric resections have been performed, two of which had division of the pancreatic ring. A cure was effected in all five. However, in one case[13] in which the ring was divided a pancreatic fistula developed. In the case presented herein there were no postoperative complications.

CASE REPORT

E. D., a fifty year old white female, was admitted to the Binghamton City Hospital with complaints of anorexia, indigestion, infrequent bouts of vomiting and an 18 pound weight loss during the preceding year and a half. The remainder of the history was noncontributory. Physical examination was essentially negative except for slight tenderness to pressure in the right upper quadrant. Complete blood count was normal except for a white blood count of 13,300 cells per cu. mm. with a normal differential. Urinalysis, the non-protein nitrogen, blood sugar, serum proteins, Thorn eosinophilia test and the 17-ketosteroid determination were normal. Two basal metabolic rates were reported as +6 and $-\frac{1}{2}$, respectively, and the electrocardiogram was considered to be within normal limits. Fluoroscopy with barium swallow revealed a large pouch arising from the postbulbar area which appeared to represent a large diverticulum of the duodenum at the junction of its first and second portions but the duodenal sweep was interpreted as normal. Radiographic examination confirmed the fluoroscopic findings of the barium swallow. (Fig. 1.) The duodenal bulb did not visualize well on most of the studies and appeared to be overlapped by a large diverticulum as described under fluoroscopy. On most of the studies there appeared to be a rather large recess on the greater curvature side of the base of the duodenal bulb. However, in a few films a line of cleavage was noted confirming the impression obtained at fluoroscopy that we were dealing with a large diverticulum immediately behind the bulb. The two-hour films showed a collection of barium in what was probably the large diverticulum described heretofore but there was no gastric residue and practically no barium within the small bowel, most of it being distributed through the colon with the head of the barium column in the region of the splenic flexure. The diagnosis was gastroptosis with a large diverticulum in the postbulbar area.

Exploratory laparotomy was done and revealed the duodenal cap to be normal, but just below the arch of the duodenum there was a marked dilatation of the passage to at least three times its normal diameter mainly on the medial aspect. Exploration immediately below the dilated area revealed an anomalous band of pancreatic tissue completely encircling the second part of the duodenum in its mid-portion. Exploration of the remainder of the pancreas revealed no pathology. Cholecystectomy and Polya type gastric resection were performed along with division of the anomalous band on the anterior surface of the duodenum. There was no ulcer in the stomach or duodenum on section. The postoperative course was uneventful and the patient was discharged on the sixteenth postoperative day. The patient has been followed up for sixteen months; and

although she had not gained any weight, she has remained completely asymptomatic.

SUMMARY

A case of annular pancreas has been presented in which the preoperative diagnosis was duodenal diverticulum. This is the fifth case on record in which the patient has been treated successfully by gastric resection and the second in which division of the pancreatic ring was done concomitantly.

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REFERENCES

1. Ecker, A. Malformation of pancreas and heart. *Ztscbr. f. rat. Med.*, 14: 254, 1862.
2. Gross, R. E. and Chisholm, T. C. Annular pancreas producing duodenal obstruction. *Ann. Surg.*, 119: 759, 1944.
3. Silvis, R. C. Annular pancreas. *Ann. Surg.*, 135: 278, 1952.
4. Wakely, J. C. M. Annular pancreas. *Lancet*, 261: 811, 1951.
5. Anderson, J. R. and Wapshaw, H. Annular pancreas. *Brit. J. Surg.*, 39: 43, 1951.
6. Shapiro, D. J., Dzurik, F. J. and Gerrish, E. W. Obstruction of duodenum in the newborn infant due to annular pancreas. *Pediatrics*, 9: 764, 1952.
7. Arey, L. B. Developmental Anatomy, 5th ed. Philadelphia, 1947. W. B. Saunders Co.
8. Lehman, E. P. Annular pancreas as a clinical problem. *Ann. Surg.*, 115: 574, 1942.
9. Payne, R. L. Annular pancreas. *Ann. Surg.*, 133: 754, 1951.
10. Custer, M. D. and Waugh, J. N. Annular pancreas with secondary dilatation of the duodenum; report of a case. *Proc. Staff Meet., Mayo Clin.*, 19: 388, 1944.
11. Olmacher, A. P. and Marshall, E. A. Annular pancreas. *Am. J. Surg.*, 79: 473, 1950.
12. Baker, J. W. and Wilhelm, M. C. Annular pancreas; report of a surgical case with a two year follow-up. *Gastroenterology*, 15: 545, 1950.
13. Cattell, R. B. Discussion of article by Payne, R. L. Annular pancreas. *Ann. Surg.*, 133: 762, 1951.
14. Ravitch, M. M. and Woods, A. C. Annular pancreas. *Surg., Gynec. & Obst.*, 50: 533, 1950.
15. Howard, N. J. Annular pancreas. *Surg., Gynec. & Obst.*, 50: 533, 1930.
16. Zech, R. L. Anomalous pancreas as a cause of chronic duodenal obstruction; report of a case. *Surgery* 39: 917, 1931.
17. Brown, M., Bingham, D. L. C. and Crowl, L. B. Annular pancreas. *Gastroenterology*, 11: 357, 1948.
18. Conroy, C. and Woeffel, G. F. Annular pancreas. *Surgery*, 29: 902, 1951.
19. Lerat, P. Contributions chirurgicale a l'etude du pancreas annulaire. *Bull. Acad. roy. de méd. de Belgique*, 24: 290, 1910.
20. Goldyne, A. J. and Carlson, E. Annular pancreas causing duodenal obstruction. *Am. J. Surg.*, 71: 429, 1946.
21. Burger, R. E. and Aldrich, E. A. Annular pancreas. *South. Surgeon*, 15: 85, 1949.
22. Haden, W. D. Annular pancreas. *Radiology*, 55: 859, 1950.
23. Vidal, E. Quelques case de chirugie pancreatique. *Proces. Verbal Assoc. Franc. de Chirugie*, 18: 739, 1905.
24. dos Santos, R. Deuz lesions rare du duodenum. *15th Congress International de Medicine, Lisbon*, 9: 419, 1906.
25. Smetana, H. Ein Beitrag zur Kenntnis der Missfildungen des Pancreas. *Beitr. z. path. Anat. u. z. allg. Path.*, 80: 239, 1928.
26. Brines, O. A. Annular pancreas associated with peptic ulcer. *Am. J. Surg.*, 12: 483, 1931.
27. Truelson, F. Annular pancreas. *Nord. med.*, 8: 2226, 1940.
28. Brines, O. A. Annular pancreas involved in acute hemorrhagic pancreatitis. *Ann. Surg.*, 92: 241, 1930.

THORACIC DUPLICATION OF ALIMENTARY TRACT

GEORGE WILLIAM WARE, M.D. AND COL. HAROLD A. CONRAD, M.C.
Washington, D. C. *Phoenixville, Pennsylvania*

IN a recent article Gross and his co-workers[34] stated: "Duplications (of the alimentary tract) are spherical or tubular structures which possess a well developed smooth muscle layer and are lined with a mucous membrane. They are found at any level from tongue to anus and usually are intimately attached to some portion of the alimentary tube."

Blasius is credited by Bremer as being the first to report this condition when in 1711 he described a case of esophageal duplication. It is our intention to record two cases of thoracic duplication of the alimentary tract and to review the English literature on this subject.

These cases have been previously reported under numerous titles. They have been described as enteric cysts, gastric cysts, esophageal duplications, mediastinal cysts of foregut origin and enterogenous abnormalities. Such a wide variety of terms tends to confuse the subject. The name, duplication of the alimentary tract, was first proposed by Ladd[42] and this phrase would seem to embrace the field. By merely adding the word thoracic or abdominal, an additional distinction is made.

A conscientious effort has been made to review the English literature and a careful search carried out for articles presented under the aforementioned titles. It is realized that single cases have frequently been reported in articles entitled "Intrathoracic Tumors," "Intrathoracic Cysts," "Mediastinal Tumors" and "Mediastinal Cysts." Numerous articles so entitled have been reviewed by the authors to obtain all previously reported cases on this subject in the English language. We have encountered seventy-nine such cases in this search and our report will bring the total to eighty-one.

We have accepted the cases reported by Lowry and Moorman, Schwarz and Williams and Blades[5] as identical cases. We have included cases which originated in the abdomen and then extended into the thoracic cavity. They are included since they presented thoracic problems in diagnosis and treatment. The cases reported by Schwarz[68] and Steele[70] may represent dermoid cysts but have been included in our statistics.

EMBRYOLOGY

This is perhaps the most fascinating aspect of the subject and one concerning which there is strong controversy. Several major theories exist:

Duplication. Bremer states that duplication occurs in the embryo of six to eight weeks. At such time epithelial cells are multiplying more rapidly than the length of the intestinal tract. The alimentary tract, therefore, goes through a solid stage with the excessive cells filling the lumen. The secretions of these excess cells cause intercellular vacuoles which are arranged in chains and often coalesce with each other and with the lumen. As the alimentary tract continues to grow, the cells normally migrate to take part in the wall of the gut. The vacuole then usually opens into the lumen and finally disappears. If the chain or row of these vacuoles persists, duplication is present. Such a theory explains how these structures in adult life may communicate with the lumen of the alimentary tract. Intimate adherence to the normal wall of the alimentary tract is plausible since duplication develops actually within the wall of the intestine. Johnson has reported these vacuoles in an embryo of 19 mm. and has presented excellent waxed reconstruction of the fetal esophagus at the stage of vacuolization.

Ladd quotes Keith as stating that the development of a duplication is actually similar to atresia. In atresia, failure of coalescence of vacuoles in the solid phase of the gut occurs in the longitudinal axis. Duplication, according to this theory, is the failure of coalescence of vacuoles in a transverse manner. Thus the cystic structure is left attached to some portion of the alimentary tract.

Diverticular Theory.[4,15,42,44] Lewis and Thyng[51] reported that diverticula normally appeared in the embryos of man, rabbit and pig. In man they can be noted as early as the 4 mm. stage. In one embryo of 23 mm. they counted

thirty-three such diverticula along the small intestine. In embryos of pigs and rabbits they noted some of the diverticula to be detached from the intestine. They observed that these diverticula normally disappear but suggested that they might give rise to pathologic conditions in later life. Bremer applied these findings to the problem at hand. He stated that development of the inner circular muscle of the bowel wall could limit their expansion except into the lumen; this could be offered as an explanation of intramural extramucosal cysts of the esophagus. If not limited by the muscular layers they could project freely into the pleural or peritoneal cavity.

Sequestration.[3,15,26,61] This theory proposes that a small piece of the primitive foregut is pinched off and at a later time undergoes development. Because of multipotential cells it may produce gastric or enteric mucosa or a combination of these. The presence of respiratory epithelium is explained by Olenick by the origin near or at the primitive lung bud.

Remnant of the Omphalomesenteric Duct. Portions of the vitelline duct are believed to be the cause. Fitz was the first proponent of this theory and pointed out that "the thoracic and abdominal cavities are not differentiated at the period in fetal life when the vitelline duct is present." Black and Benjamin quote in their article that these remnants "wander about until they find some resting place." Such wandering explains location at various levels.

Organizer Substance. This particular theory was first proposed by Needham and has been discussed by Cassel, Ehler, Schwarz and Williams. This argument maintains that there is an organizer hormone present in the ovum. This substance influences the essential form of certain cells and will influence similar cells in a different manner according to the location of the cell.

Abnormal Twinning Theory. Hudson postulates an origin of duplications of the alimentary tract similar to that of dermoids and teratomas. In this instance at hand the stimulation to reduplication affects only a certain portion or section of the embryo.

STATISTICS

The patients in this group (eighty-one cases) varied from stillborn fetuses to persons fifty-three years of age. The majority, however, were in infancy. Thirty-five were in the first twelve months of life; eighteen patients were twelve years of age or over. There were thirty-nine males and twenty-three females. In nineteen the sex was not mentioned. There were forty-four white patients and one Negro. In thirty-six instances the race was not indicated.

Forty-seven cases involved the right side and twenty-three involved the left side; in eight the position in the thorax was not noted and in three the mass projected into both the right and left hemithoraces. The preponderance of involvement of the right pleural cavity is explained by Bremer as follows: "The right pleural cavity is the one usually invaded because since the torsion of the stomach (dorsal wall to the left) is continued along the esophagus for some distance, the entire mesenteric or ventral surface of the latter along which the diverticulum develops points slightly to the right."

Certain symptoms were noted frequently enough to be of importance. These included dyspnea, cyanosis, cough, vomiting and failure to gain weight. Occasional complaints were dysphagia, chest pain and repeated pneumonia. Unusual complaints were hemoptysis, hematemesis, abdominal pain or hoarseness. In nine cases there were no symptoms whatsoever, the mass being noted on a routine x-ray.

There was nothing diagnostic in the physical examination of the patients reported herein. Findings when present were those of a mass or consolidation in the chest, e.g., dullness on percussion. The heart was shifted in four. In two patients a mass could be felt in the neck. An associated diaphragmatic hernia resulted in the auscultation of peristaltic sounds in the chest. In sixteen cases physical examination was entirely negative.

Again there was nothing diagnostic about chest x-ray. The most common x-ray report was a round, well defined mass in the posterior mediastinum (twenty). Other interpretations were mass in chest (nine), mediastinal shift (eight), atelectasis (three) and cysts with fluid (three). In some cases barium swallow of the esophagus was more important, as for example, in cases of duplication of the esophagus. In one instance of duplication of the esophagus the postero-anterior chest film was negative; however, an oblique film was abnormal.[66]

A large number of congenital defects were present, but it should be noted that many of these defects were in the same patient. We

know of no explanation for the large number of concomitant orthopedic diagnoses. In one patient there were two thoracic duplications which were unconnected.[64] In three patients there were associated small bowel duplications.[4,34,64] In one of the latter the patient underwent surgery for the abdominal condition and the thoracic tumor was discovered only at autopsy.[34] Table 1 lists the associated anomaly or disease.

TABLE 1
ASSOCIATED ANOMALY OR DISEASE

Hemivertebra	15
Peptic ulcer	14
Spina bifida	5
Scoliosis	5
Mental retardation	2
Otitis media	2
Erosion of ribs/vertebra	2
Inguinal hernia	2
Bronchiectasis	2
Reduplication of ileum	2
Subdural hematoma	2
Clubfoot	1
Reduplication of jejunum	1
Two thoracic duplications	1
Meningococele	1
Malrotation of colon	1
Carcinoma of esophagus	1
Meckel's diverticulum	1
Umbilical hernia	1
Diaphragmatic hernia	1
Bilobed right lung	1
Hydrocephalus	1
Heart disease	1
Prematurity	1
Pigeon breast	1
Ventricular septal defect	1
Carcinoid of ileum	1
Epigastric hernia	1

Peptic ulceration constituted a definite menace in the gastric variety and occurred in fourteen of the cases reported herein. Such a condition leads to early symptoms and possibly death of the patient. In four instances it was the cause of an abnormal communication with the pulmonary system and resultant pulmonary suppuration. These cases are reported by Dickson, Gross, Ward and Valle. In two patients there were co-existent duplications of the small bowel.[4,64] In these patients the ulcers occurred in the small bowel and were the source of severe hemorrhage. This was the reason for the patient then seeking medical treatment.

Treatment. Originally no treatment was planned since these conditions were merely autopsy curiosities. With present day concepts of thoracic surgery, excision has become the accepted treatment.

X-ray has been used in six patients as a therapeutic as well as a diagnostic procedure.[12,13,47,66] As might be expected, such treatment was fruitless.

Thoracentesis of the mass has been done in a number of cases.[11,14,16,25,44,50,52,54,59,69,76] In certain instances it was done with a misdiagnosis of empyema, pleural effusion or infected cyst. In some of the cases, when the fluid which was aspirated was analyzed, it was concluded to be gastric juice.[25,54] Because of this possibility of a preoperative diagnosis, aspiration of the mass has been recommended.[19,60,75] It should be noted that in most cases aspiration did not give the correct answer although the persons aspirating the thorax considered this diagnosis a possibility.[59,68,74–76] In these cases straw-colored or light yellow fluid was obtained. There was no evidence of pepsin or hydrochloric acid on laboratory examination and often the fluid was neutral in reaction. Some authors (Ehler and Lindquist) have condemned aspiration of the fluid because of the danger of infection or leakage of the acid fluid. We do not believe that aspiration of such a cyst need be dangerous. A diagnosis of thoracic duplication should not be discarded if acid fluid is not found. It should be remembered that not all duplications have gastric mucosa and even those with gastric mucosa need not produce acid fluid.

Surgery. Some form of surgery had been performed in sixty-three instances. The ideal treatment of these tumors is total excision. In a number of cases several operations have been necessary to excise the mass totally. This has been especially true in the abdominothoracic cases.[21,27,28,33,34]

In some cases total excision has not been feasible. The reasons for this have been extension below the diaphragm,[14,47,68,73] extension up into the neck[25] or extension from abdomen to thorax.[33] Subtotal excision was also done in some cases because of the intimate connection with the esophagus.[44,75] Ladd has pointed out that the muscular wall of the duplication is "an integral part of the muscularis of the alimentary tract." Hence the cyst cannot be dissected off the esophagus and persistent efforts to do so will result in injury to the esophagus.

Marsupialization followed by partial or total excision was carried out as the procedure of choice in eight cases.[11,34,44,59,67] A two-stage total

excision was reported by Linder. In one patient thoracotomy alone was performed.[44] In three cases pulmonary resection (lobectomy in two, pneumonectomy in another) was necessary because of associated suppurative changes due to peptic ulceration. These cases were those of Dickson, Gross and Valle. In two cases rib resection followed by thoracoplasty was first performed due to diagnosis of empyema.[52,59] Both patients were successfully treated when the true diagnosis became apparent.

TABLE II
HISTOLOGY

Gastric	30
Esophageal	21
Gastric plus enteric	6
Enteric	4
Gastric plus enteric plus pancreatic	4
Gastric plus esophageal	3
Esophageal plus enteric	2
Gastric plus eosphageal plus respiratory	1
Gastric plus respiratory	1
Enteric plus colonic plus respiratory	1
Colonic	1
Unknown	7

The postoperative complications were not marked. There were two cases of Horner's syndrome.[63,76] There was one instance of postoperative osteomyelitis of the spine following marsupialization[44] and another of esophagopleural fistula.[44] One case was complicated by postoperative hemorrhage.[44] A diagnosis of "cardiospasm" secondary to surgery was made in a patient reported by Dohn and Povlson.

Histology. The types of mucosa found in the duplications are grouped in Table II. It is seen that the gastric variety is predominant. Such predominance would suggest the usual origin from that portion of the foregut which ultimately becomes stomach. The frequency of association between esophageal and enteric types can easily be explained by borderline involvement of such cells. This is all the more understandable when it is realized as pointed out by Bremer that an area of gut which is 2 mm. in the embryo equals 2 meters of alimentary tract in the newborn.

The infrequent occurrence of respiratory mucosa would suggest that development usually occurs after separation of esophagus and trachea. In evaluating mucosal types reported it must be remembered that the fetal esophagus has ciliated columnar and squamous cells in the mucosa.[38,65]

Unusual Aspects. The abdominothoracic diverticula originated from small bowel and extended up into the chest. They usually presented thoracic symptoms and findings on admission. (Table III.)

One case is mentioned which had a connection with the esophagus. This was demonstrated by barium swallow.[31] The patient received no treatment. He was examined seven years after the first series and had few symptoms. At the time of the second examination one loop or channel had become much smaller while the second had assumed most of the function of the swallowing.

TABLE III
UNUSUAL ASPECTS

Extension from abdomen to thorax	7
Extension from thorax to abdomen	4
Communication with bronchial tree	4
Extension into neck	3
Thoracic and abdominal duplications	3
Communication with esophagus	2
Calcification in mass	2
Two thoracic duplications	1
Carcinoma of esophagus	1

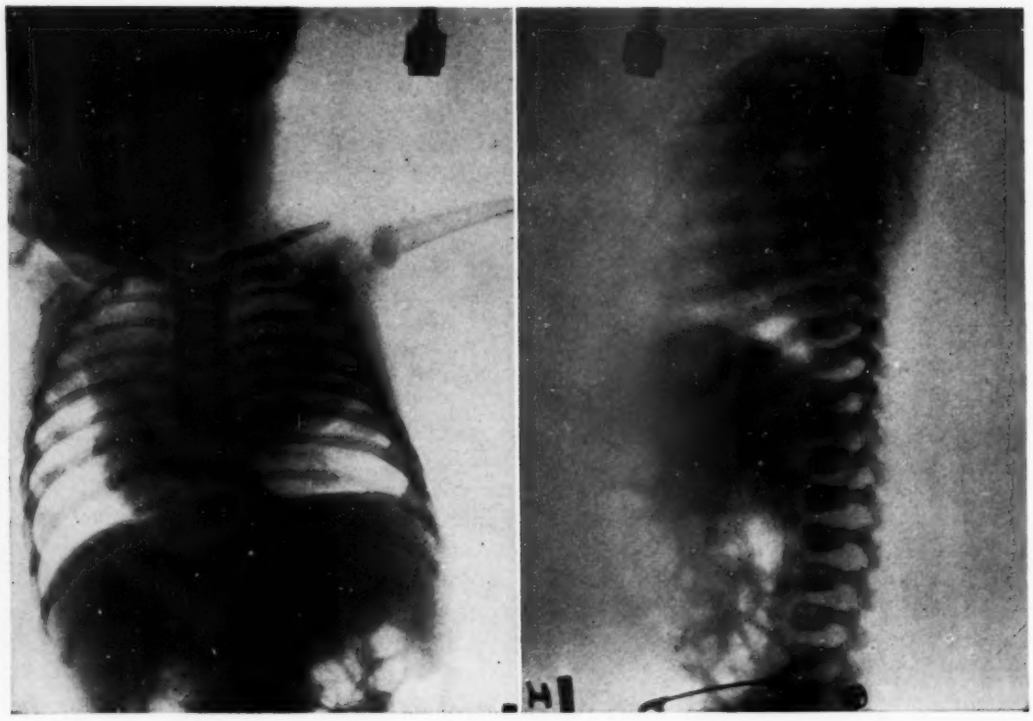
TABLE IV
RESULTS OF SURGERY

	No. of Cases	Alive	Dead
Total excision	35	33	2
Partial excision	9	5	4
Marsupialization plus total excision	2	1	1
Marsupialization plus partial excision	6	5	1
Exploration	1	0	1
Pulmonary surgery plus excision	3	2	1
Incomplete details	7	6	1

The cases mentioned as showing calcification by x-ray might have represented dermoid cysts.[68,70]

The case of carcinoma presented an unusual problem.[10] The patient appeared with metastases. Barium studies were negative. Dysphagia appeared late. At autopsy duplication of the esophagus was found. The normal esophagus was patent and entered the stomach normally. The "second esophagus" was involved by massive carcinoma and entered the stomach at a more distal point.

Cases of communication with the bronchial tree were due to peptic ulceration and erosion.[23,34,73,74] These cases, as mentioned, were complicated by pulmonary suppuration.



1 2

FIGS. 1 and 2. Case 1. Preoperative chest films.

Mortality. Sixty-three patients underwent surgery and fifty-two lived. Table IV subdivides these cases. Eighteen patients received no treatment. One patient was alive with few symptoms seven years after a diagnosis by barium swallow of duplication of the esophagus. In the remaining patients the condition was the major cause of death in eleven, the contributing cause in two and an incidental finding in four.

It should be noted that peptic ulceration was noted in fourteen cases and five of these ended fatally.

CASE REPORTS

CASE 1. A male infant, aged three months, was transferred to Valley Forge Army Hospital on May 23, 1949, for observation and treatment of an undiagnosed tumor in the left upper chest. The patient had originally entered a hospital in Germany for phimosis. During the period of hospitalization the patient ran an elevation of temperature to 101°F. and seemed to have a slight cough. A chest x-ray was taken and reported to show a haziness in the upper two-thirds of the left lung field and shift of the heart and mediastinum to the right side.

Past history was entirely normal. At physical examination auscultation of the lungs revealed dullness to percussion on the left side posteriorly, especially in the upper half of the lung field. There were scattered rhonchi bilaterally, most marked in the left upper lung field anteriorly. Laboratory work was within normal limits.

X-ray interpretation at this hospital was as follows (Figs. 1 and 2): "Films of the chest, 13th May 1949, show a blunt shaped cone with its base against the posterior gutter on the left. The mass measures 5 cm. across the base, 4 cm. in height. The apex is round and the margins are sharply demarcated. The mass displaces the heart and upper mediastinum towards the right. The lung fields appear to be clear and the mass does not seem associated with the mediastinum. The vertebral column is deviated slightly to the right at the level of the mass. There is no bone erosion. The process appears to be an intrathoracic lesion most probably of nerve origin."

The patient was seen in consultations both by a civilian pediatrician and a thoracic-surgical consultant. Because of the nature of the mass surgery was deemed necessary. On June 18, 1949, a left thoracotomy was performed. A posterolateral incision was made. On opening the thorax a large, tense, well encapsulated subpleural mass was immediately evident filling the posterolateral portion of the left thoracic

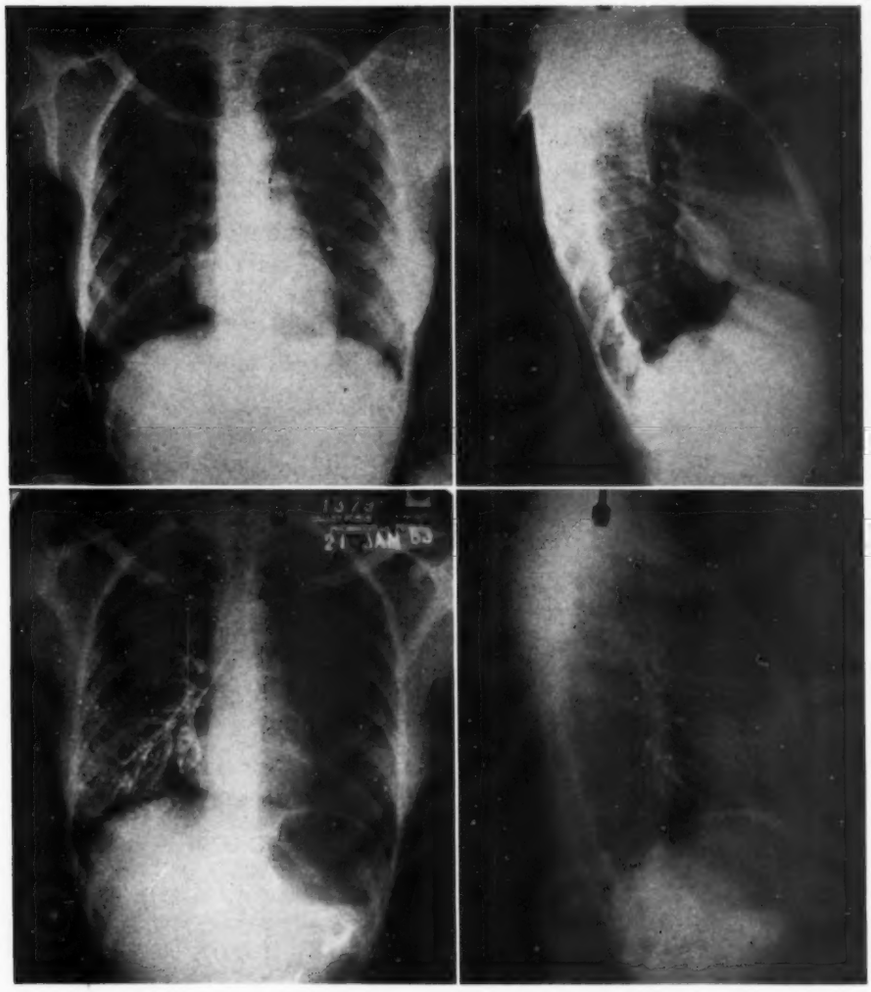


FIG. 3. Case 11. Preoperative postero-anterior and lateral chest films. FIG. 4. Same case. Preoperative bronchograms.

cavity. The mass was approximately 6 by 8 cm. in size, oval in shape. The lung was adherent to its anterolateral aspect by means of moderately thick adhesions which were divided. No connection between the mass and esophagus could be demonstrated. It was aspirated and about 35 cc. of thin, cloudy fluid were obtained, resulting in a reduction of the size of the mass to approximately 40 per cent. The mass was then removed by sharp and blunt dissection, and the specimen was sent to the laboratory for section. Routine chest closure was performed.

Pathologic description of the mass is as follows: Grossly, the mass from the thorax was a regular ovoid unilocular cyst, 4.5 by 3½ by 2.6 cm. The wall was pliable, pale and varied from .3 to .9 cm. in thickness. The inner surface of the cyst was mucosalized, finely granulated and in places it varied from gray to light and dark tan.

Microscopically, multiple sections showed a mucosal lining consisting of a moderate amount of small glands which were lined by a single layer of cuboidal to columnar cells. The surface of the mucosa was covered with a single layer of pale columnar cells without cilia. Portions of the inner surface of the cyst were not lined by mucosa. The surface here was covered by mixed fibers and some acute and chronic inflammatory cells. The mucosa lay on a slender to moderate layer of smooth muscle. Beneath this there was a loosely arranged fibrous tissue zone containing small vascular channels, and the most external zone of the wall was relatively thick, smooth muscle. There was some variability of the thickness of mucosal wall. In the wall of this cyst was also noted the presence of mucosa in a very few locations, having the architecture associated with oxyntic type cells in the deeper portions suggesting a gastric ele-

ment. One portion of the wall contained in the submucosal zone an aggregate of glandular type tissue arranged in lobules consisting of small ducts suggestive of pancreas.

Analysis of the contained opalescent fluid removed from the cyst by aspiration is as follows: specific gravity 1.009, protein 2.32. Smear showed rare pus cells, no organisms. Cultures showed no growths. Diagnosis: enteric cyst of the thorax with (1) intestinal mucosa lining, (2) focal areas of gastric mucosa, (3) pancreatic tissue and submucosa. The postoperative course was without incident.

CASE II. A twenty year old Negro girl was admitted to Valley Forge Army Hospital on January 13, 1953. The patient first came to medical attention in Germany when a close friend was found to have tuberculosis. A routine chest film revealed a right thoracic tumor. She was transferred to Valley Forge Army Hospital for further treatment.

The patient was completely asymptomatic. There were no abnormal physical findings and laboratory work was within normal limits.

On x-ray a spherical 6 cm. mass was seen which lay adjacent to the right border of the heart. There was no change on inspiration or expiration, or with Trendelenburg position during fluoroscopy. With a barium swallow the esophagus was displaced to the left and anteriorly by the mass. (Figs. 3 and 4.)

Bronchoscopy was negative. A right bronchogram showed a normal bronchial tree. There was no connection between the mass and the bronchial system.

A right thoracotomy was performed on January 26th with a preoperative diagnosis of pericardial cyst. The sixth rib was resected subperiosteally. A cystic structure could be seen and palpated in the inferior pulmonary ligament. With dissection it was found to be adherent to the undersurface of the lower lobe and pericardium. Its origin was from the esophagus whose muscular fibers partly encircled the mass. The cyst was ruptured during dissection and thick, yellow, mucoid material escaped. The esophageal lumen was not entered. Routine closure was performed.

The pathologic report was as follows: Grossly, the cyst was filled with mucoid material. Microscopic examination: "Sections consist of smooth muscle and fibrous tissue in which there are numerous blood vessels. The stroma is thrown into numerous papillary projections which are covered by pseudostratified ciliated epithelium. Amorphous pink-staining covers the epithelium." Diagnosis: foregut cyst. The postoperative course was uneventful.

SUMMARY

A review of the literature on thoracic duplication of the alimentary tract is presented and two additional cases are reported. Various theories of origin of these lesions are outlined. Surgical methods of treatment are investigated and results of these methods are reported.

Acknowledgment: We wish to express our gratitude to Mrs. Bernadine T. Collins and Mrs. Lisabeth M. Holloway of the library staff of Valley Forge Army Hospital. Only by their constant interest and fine investigative efforts has such a review been possible. We are also indebted to Miss Rae Desimone for assistance in preparation of this manuscript.

REFERENCES

1. BAAR, H. S. and D'ABREU, A. L. Duplications of foregut. *Brit. J. Surg.*, 37: 220–229, 1949.
2. BATTERSBY, J. S. Duplication of esophagus. *Quart. Bull. Indiana Univ. M. Center*, 12: 10, 1950.
3. BICKFORD, B. J. Mediastinal cysts of gastric origin. *Brit. J. Surg.*, 36: 410–413, 1949.
4. BLACK, R. A. and BENJAMIN, L. Enterogenous abnormalities, cysts and diverticula. *Am. J. Dis. Child.*, 51: 1126–1137, 1936.
5. BLADES, B. Relative frequency and site of predilection of intrathoracic tumors. *Am. J. Surg.*, 54: 139–148, 1941.
6. BLADES, B. Mediastinal tumors. *Ann. Surg.*, 123: 749–765, 1946.
7. BRADFORD, M. L., MAHAN, H. W. and GROW, J. B. Mediastinal cysts and tumors. *Surg., Gynec. & Obst.*, 85: 467–491, 1947.
8. BREMER, J. L. Description of a 4 mm. embryo. *Am. J. Anat.*, 5: 459–479, 1906.
9. BREMER, J. L. Diverticula and duplications of the intestinal tract. *Arch. Path.*, 38: 132–140, 1944.
10. BUTLER, C. L. and ENDE, M. Double esophagus with carcinoma in one. *Arch. Path.*, 49: 605–611, 1950.
11. CARLSON, H. A. Congenital cysts of the mediastinum. *J. Thoracic Surg.*, 12: 376–393, 1943.
12. Case Records of Massachusetts General Hospital. *New England J. Med.*, 223: 105, 1940.
13. Case Records of Massachusetts General Hospital. *New England J. Med.*, 233: 278–281, 1945.
14. Case Records of Massachusetts General Hospital. *New England J. Med.*, 242: 223–227, 1950.
15. CASSEL, M. A., CUNNINGHAM, R. T. and WEISEL, W. A. Foregut cyst of mediastinum. *J. Thoracic Surg.*, 19: 138–144, 1950.
16. CAUTLEY, E. A. Malformation of the esophagus. *Brit. J. Child. Dis.*, 14: 1–10, 1917.

17. Christoffersen, J. C. Intrathoracic gastric cyst. *Acta chir. Scandinav.*, 96: 12–16, 1947.
18. Curreri, A. R. and Gale, J. W. Mediastinal tumors. *Arch. Surg.*, 58: 797–818, 1949.
19. Davidson, L. R. and Brown, L. Gastrogenous mediastinal cyst. *J. Thoracic Surg.*, 16: 458–467, 1947.
20. Davis, E. W. and Salkin, D. Intrathoracic gastric cysts, *J. A. M. A.*, 135: 218–221, 1947.
21. Davis, J. E. and Barnes, W. A. Intrathoracic duplications of the alimentary tract communicating with the small intestine. *Ann. Surg.*, 136: 287–295, 1952.
22. DeBakey, M. E. and Creech, O. Tumors of the mediastinum. *Texas State J. Med.*, 46: 588–596, 1950.
23. Dickson, J. A., Clagett, O. T., McDonald, J. R. Intrathoracic gastric cyst. *J. Thoracic Surg.*, 15: 318–323, 1946.
24. Dohn, K. and Povlsen, S. Enterocystoma. *Acta chir. Scandinav.*, 102: 20–35, 1951.
25. Ehler, A. A. and Atwell, S. Gastric cyst of mediastinum. *J. Thoracic Surg.*, 17: 809–820, 1948.
26. Evans, A. Developmental enterogenous cysts and diverticula. *Brit. J. Surg.*, 17: 34–83, 1929.
27. Field, A. H. Quoted by Davis and Barnes. *Ann. Surg.*, 136: 287, 1952.
28. Fisher, H. C. Duplication of intestinal tract in infants. *Arch. Surg.*, 61: 957–974, 1950.
29. Fitz, R. H. Persistent omphalo-mesenteric remains. *Am. J. M. Sc.*, 88: 30–59, 1884.
30. Fletcher, H. M. A congenital cyst of the mediastinum. *Tr. Path. Soc. London*, 48: 249–251, 1897.
31. Frank, R. C. and Paul, L. W. Congenital reduplication of esophagus. *Radiology*, 53: 417–419, 1949.
32. Gledhill, E. Y. and Morrow, A. G. Ciliated epithelial cyst of the esophagus. *J. Thoracic Surg.*, 20: 923–927, 1950.
33. Gross, R. E., Neuhauser, B. D. and Longino, L. A. Thoracic diverticulae which originate from intestine. *Ann. Surg.*, 131: 363–375, 1950.
34. Gross, R. E., Holcomb, G. W. and Farber, S. Duplication of the alimentary tract. *Pediatrics*, 9: 449–468, 1952.
35. Heuer, G. J. and Andrus, W. DeW. Surgery of mediastinal tumors. *Am. J. Surg.*, 50: 146–224, 1940.
36. Holinger, P. H., Johnson, K. C. and Potts, W. J. Congenital anomalies of the esophagus. *Ann. Otol., Rhin. & Laryng.*, 60: 707–730, 1951.
37. Hudson, H. W., Jr. Giant diverticula or reduplications of the intestinal tract. *New England J. Med.*, 213: 1123–1131, 1935.
38. Johnson, R. P. Development of mucous membrane of the esophagus, stomach and intestine in human embryo. *Am. J. Anat.*, 10: 521–561, 1910.
39. Jones, J. C. Esophageal duplications or mediastinal cysts of enteric origin. *West. J. Surg.*, 55: 610–617, 1947.
40. Kinsella, T. J. Thoracic Tumors in Diagnosis and Management of the Thoracic Patient, pp. 162–203. Edited by Bailey, C. P. Philadelphia, 1945. J. B. Lippincott Co.
41. Kinsella, T. J. Symposium on thoracic surgery; thoracic tumors. *Clinics*, 3: 1246–1287, 1945.
42. Ladd, W. E. Duplications of the alimentary tract. *South. M. J.*, 30: 363–371, 1937.
43. Ladd, W. E. and Gross, R. E. Surgical treatment of duplications of the alimentary tract. *Surg., Gynec. & Obst.*, 70: 295–307, 1940.
44. Ladd, W. E. and Scott, H. W., Jr. Esophageal duplications or mediastinal cysts of enteric origin. *Surgery*, 16: 815–835, 1944.
45. Ladd, W. E. Congenital anomalies of the esophagus. *Pediatrics*, 6: 9–19, 1950.
46. Laipply, T. C. Cysts and cystic tumors of the mediastinum. *Arch. Path.*, 39: 153–161, 1945.
47. Langston, H. T., Tuttle, W. M. and Patton, T. B. Esophageal duplications. *Arch. Surg.*, 61: 949–956, 1950.
48. LaTona, J. H. and Coleman, F. C. Congenital gastro-enteric cysts of the thorax. *J. Iowa M. Soc.*, 38: 11–13, 1948.
49. Lawrence, E. A. Mediastinal tumors of a surgical nature. *Rocky Mountain M. J.*, 47: 257–265, 1950.
50. Leahy, L. J. and Butsch, W. L. Surgical management of respiratory emergencies during first few weeks of life. *Arch. Surg.*, 59: 466–483, 1949.
51. Lewis, F. T. and Thyng, F. W. The regular occurrence of intestinal diverticula in embryos of the pig, rabbit and man. *Am. J. Anat.*, 7: 505–519, 1907.
52. Linder, H. Intrathoracic gastro-enteric cysts. *Surgery*, 25: 862–868, 1949.
53. Lindquist, N. and Wulff, H. B. Mediastinal enterocystoma. *J. Thoracic Surg.*, 16: 468–476, 1947.
54. Lowry, T. and Moorman, L. J. Accessory stomach in right thorax. *Am. Rev. Tuberc.*, 38: 27–31, 1938.
55. Mixter, C. G. and Clifford, S. H. Congenital mediastinal cysts of gastrogenic and bronchogenic origin. *Ann. Surg.*, 90: 714–729, 1929.
56. Moersch, H. J. and Harrington, S. W. Benign tumors of esophagus. *Ann. Otol., Rhin. & Laryng.*, 53: 800–817, 1944.
57. Myers, R. T. and Bradshaw, H. H. Benign intramural tumors of esophagus. *J. Thoracic Surg.*, 21: 470, 1951.
58. Needham, J. Developmental physiology. *Ann. Rev. Physiol.*, 1: 63–80, 1939.
59. Nicholls, M. F. Intrathoracic cyst of intestinal structure. *Brit. J. Surg.*, 28: 137–143, 1940.
60. Olenik, J. L. and Tandatnick, J. W. Congenital mediastinal cysts of foregut origin. *Am. J. Dis. Child.*, 71: 466–476, 1946.
61. Olken, H. G. Congenital gastro-enteric cysts of the mediastinum. *Am. J. Path.*, 20: 997–1009, 1944.
62. Patterson, E. J. Congenital cyst of esophagus. *Ann. Otol., Rhin. & Laryng.*, 43: 884–886, 1934.
63. Pilcher, R. S. Intrathoracic cyst of gastric type. *Proc. Roy. Soc. Med.*, 37: 576, 1944.
64. Poncher, H. G. and Milles, G. Cysts and diverticula of intestinal origin. *Am. J. Dis. Child.*, 45: 1064–1078, 1933.
65. Ranstrom, S. Congenital cysts of the esophagus. *Acta oto-laryng.*, 33: 487–495, 1945.
66. Rosenak, B. D. and Van Vactor, H. D. Extramucosal intramural enteric cyst of esophagus, a case report. *Am. J. Roentgenol.*, 66: 81–86, 1951.

67. Sabiston, D. C., Jr. and Scott, H. W., Jr. Primary neoplasms and cysts of mediastinum. *Ann. Surg.*, 136: 777, 1952.
68. Schwarz, H. and Williams, C. S. Thoracic gastric cysts. *J. Thoracic Surg.*, 12: 117–130, 1942.
69. Smith, R. E. A case of mediastinal dermoid cyst in an infant. *Guy's Hosp. Rep.*, 80: 466–469, 1930.
70. Steele, J. D. and Schmitz, J. A mediastinal cyst of gastric origin. *J. Thoracic Surg.*, 14: 403–406, 1945.
71. Thompson, J. V. Mediastinal cysts and tumors. *Internat. Abstr. Surg.*, 84: 195–221, 1947.
72. Turner, G. G. Injuries and diseases of the esophagus. *Newcastle M. J.*, 22: 53–99, 1945.
73. Valle, A. R. and White, M. L., Jr. Thoracic gastric cyst. *Ann. Surg.*, 123: 377–383, 1946.
74. Ward, I. M. and Krahl, J. B. Enterogenous pulmonary cyst. *Am. J. Dis. Child.*, 63: 924–933, 1942.
75. Williams, M. H. and Johnson, J. F. Mediastinal gastric cyst. *Arch. Surg.*, 64: 138–147, 1952.
76. Wyllie, W. G. and Pilcher, R. S. Intrathoracic cysts of intestinal and bronchial structure. *Arch. Dis. Childhood*, 18: 34–40, 1943.

Correction: Through an oversight the name of Dr. M. M. Simon was misspelled in Dr. Donald E. Ross' article on page 729 in our June 1953 issue.

COMPLICATIONS FOLLOWING OPEN REDUCTION AND PLATING OF FRACTURES OF THE TIBIA*

COMDR. HOWELL E. WIGGINS, M.C., COMDR. WARNER D. BUNDENS, M.C.
AND LIEUT. BYRON J. PARK, M.C.
Philadelphia, Pennsylvania

BECAUSE of the combined utilization of the facilities of the U. S. Naval Hospital, Philadelphia, Pennsylvania, by the Veterans Administration and the United States Navy, we have seen a total of 139 tibial shaft fractures during the period from January, 1951, to October, 1952. In this group there were fifty-three complications (38.1 per cent), of which there were eleven malunions, eight non-unions, seven delayed unions and twenty-seven cases of osteomyelitis. The percentage of complications would seem to be extremely high were it not for the fact that a large number of these fractures were combat-incurred, with resultant unavoidable complications. However, our attention was drawn to the fact that eleven or 20.7 per cent of the patients with complications had undergone tibial plating for both open and closed fractures prior to their transfer to our service.

Because of the rather widespread utilization of open reduction and internal fixation in tibial fractures,[1-3,5,6,9,10,12] it is believed that some historical background might be pertinent.

Although there were isolated incidences of open reduction and fixation of fractures of the long bones with metallic material as early as 1775, the popularization of this method of treatment of fractures was accomplished by one man, W. Arbuthnot Lane, who began this method of treatment as early as 1892,[4] three years prior to the discovery of x-rays by Roentgen. In 1905 Lane published a monumental work on open reductions of fractures using fixation devices. In this treatise Lane stressed asepsis, used no sutures deep in the wounds for fear of contamination and was emphatic in his belief that open reductions should not be reserved for only the old complicated cases but should be considered as a primary procedure to prevent these complications. In 1910 Lane toured the United States in order to present his new approach to the treatment of fractures, and in an article, summarized his use of plates and screws in the operative treatment of fractures.[7] In his opening paragraph Lane stated: "In deciding as to whether the surgeon should operate upon any particular fracture, or whether he should be satisfied to treat the case by manipulation, splints, massage, active and passive movements, etc., the importance or need of restoring the fractured bone or bones to their normal form should be the guide. It is obvious that if there is no displacement of fragments, or if the displacement can be overcome by manipulation, etc., no operation is required in the ordinary case. Until surgeons generally have improved their technique sufficiently, and have acquired a greater familiarity with the operative treatment of fractures, a varying degree of risk must necessarily accompany any open operation, and this danger must be taken into consideration. It is necessary that an asepsis must be observed which is far superior to that requisite for other operations, because a considerable quantity of metal is left in the wound. Again, these operations may be very difficult to perform, and those assisting the surgeon require special knowledge and experience. However, if the surgeon is careful and familiar with these operations, and his assistants are efficient and reliable, there is practically no risk in the operation, and, unless the bone is too thin, too soft, or too much comminuted, he ought to be able to obtain a perfect result anatomically and functionally."

With specific reference to fractures of the tibia, Lane[8] stated that the surgeons should, if possible, put the plate on the surface of the

* Presented before the joint meeting of the Philadelphia and New York Regional Committees on Trauma of the American College of Surgeons, December 13, 1952, Philadelphia, Pa. The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

bone which is covered by muscle and so avoid any irritation of the skin by the bulk of the plate. In addition the plate should hold the fragments with complete security and in a condition of absolute immobilization.

It is interesting to note the reason that Lane came to utilize screws and plates in the treatment of tibial fractures and for this we would again like to quote from his writings:

" . . . Why should we hesitate for one moment to bring common-sense preclinical principles to bear in the case of simple fractures of the tibia and fibulae, when most surgeons of the present day would not dream of doing otherwise in the case of a fracture of the patella with separation of the fragments? . . . Now as regards the best means of fixation of the fragments; in my earlier cases I used silver wire, but soon gave it up . . . One frequently found that no amount of traction upon the ends of the wires could retain the surfaces in accurate apposition after the grip of the Lion forceps was relaxed. Therefore, I decided to treat the bones as one would the broken leg of a table or chair. The surfaces were brought into accurate apposition, and kept in their normal relationship by Lion forceps. Holes were drilled above and below the forceps and screws were driven in. The screws could be driven in any direction, and they retained the surfaces in apposition more accurate and more forcible then I fancy can be obtained by any other mechanical arrangement."

This passage, written in 1894, is believed to be particularly apropos in view of a paper published as recently as 1941 by Mansfield,[9] who utilized silver wire in the fixation of all his oblique spiral fractures of both bones of the leg.

One of the converts of Lane in this country was Murray, who followed his teachings[11] and added a number of refinements[12] to Lane's technic.

Murray was a prolific writer and contributed many papers in medical journals with regard to open reduction and internal fixation of fractures of the long bones. Because of this work a belief apparently developed among the surgeons of this country who handle fractures that open reduction and internal fixation of fractures of the long bones was the method of choice. However, if one carefully reads the many articles on this subject contributed by Murray, it becomes at once apparent that he did not advocate the utilization of open reduction and internal fixation in all fractures of the long bones. In addition Murray presented a most meticulous operative technique which it is thought that the majority of surgeons performing operative interference in fracture work do not follow. Outstanding among these axioms were early operative intervention, anatomic reduction, strict asepsis, absolute rigid fixation and the absence of any type of postoperative immobilization. Murray believed that if these factors were observed, excellent results could be anticipated in this method of treatment of fractures.

In January, 1949, McLaughlin[10] presented the results of 137 consecutive shaft fractures of the tibia treated by open reduction and internal fixation. One hundred twenty-one of these cases were considered to have been adequately followed up, and of this number there were only seven non-unions. Of the seven non-unions, six occurred in open fractures of the tibia.

It is interesting to note that in the discussion which followed the presentation of this paper Mr. H. Osmond Clarke of London, England, stated that in his opinion the safest method for treating fractures was to reduce them with your two hands and hold the fragments in place with plaster-of-paris.

Dr. H. Earle Conwell believed that only in clinics such as those organized by Darrach and Murray could results such as those reported by McLaughlin be obtained. Conwell went on to say that "Last but not least, it is well to remember that a surgeon is not one who incises and thinks but one who first thinks and reasons and in most instances does not incise." It was his opinion that McLaughlin's presentation should be for individual consumption and not for general distribution.

Dr. R. I. Harris of Toronto, Canada, stated: "Fractures do not lend themselves to complete regimentation, as in the case in other fields of surgery, because they differ profoundly one from the other, even in the same bone." It was his further opinion that "Many fractures demand for their best treatment more or less laboratory apparatus, the highest technical equipment from hospitals, the greatest skill in the use of that technical equipment and experience and skill on the part of the surgeons; but fractures do not always occur in places or under circumstances where these are available. Therefore, what is justifiable in the hands of a

trained surgeon in one place in a properly equipped hospital is entirely unjustifiable elsewhere."

The plating of tibial shaft fractures is now widely accepted by many surgeons. However, it is our firm conviction that we would be derelict in our duty to the profession if complications of tibial plating were not presented in order to provide a basis of re-evaluation of this relatively common surgical practice.

TABLE 1

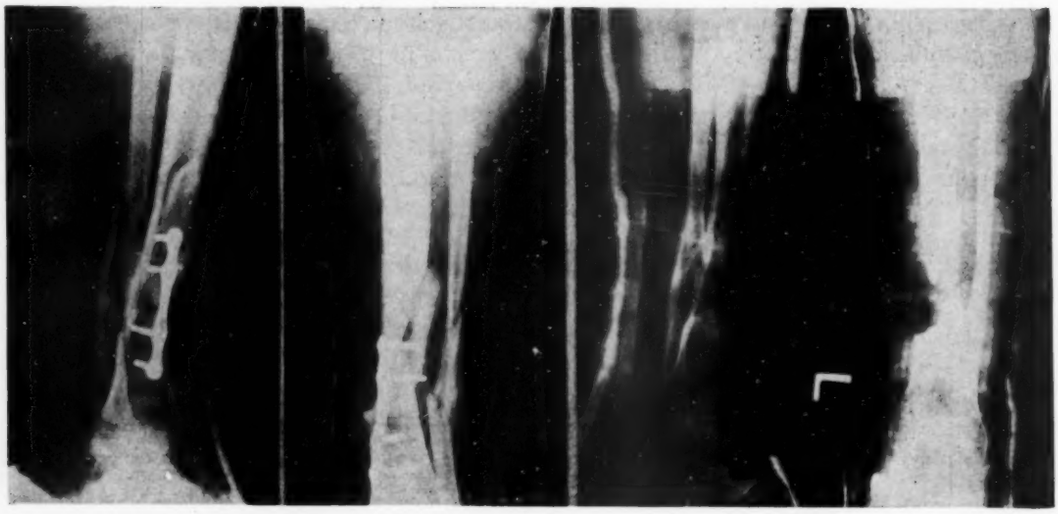
Type of Fracture	Date of Injury	Time Interval from Injury to Operative Interference	Complications Following Plating	No. of Months under Treatment	Remarks
Open comminuted	May 7, 1952	4 hr.	Gross infection, non-union, skin loss	27	Below-knee amputation performed in March, 1952
Closed comminuted	Nov. 14, 1948	6 wk.	Gross infection, skin loss, delayed union	48	Patient still under treatment; tibia clinically solid but cross leg flap will be required to cover skin defect
Open comminuted	June 26, 1949	48 hr.	Gross infection, delayed union, skin loss	42	Drainage slowly diminishing following several sequestrectomies; will require cross leg pedicle flap to cover skin defect
Open comminuted	Nov. 18, 1951	7 hr.	Gross infection, non-union	6	Transferred to VA Hospital with drainage and non-union
Open comminuted	Dec. 30, 1949	6 days	Infection, skin loss, loss of alignment, delayed union	33	Although solid healing occurred with good alignment, plastic surgery is still needed to close the skin defect
Closed transverse	Feb. 23, 1951	4 hr.	Infection, distraction, delayed union	18	Union finally occurred and drainage ceased following removal of plate and screws
Closed transverse	June 2, 1951	8 days	Delayed union	10	None
Open transverse	May 10, 1951	6 hr.	Gross infection, non-union	19	Although all drainage has ceased, patient still has non-union
Open comminuted	Dec. 28, 1949	72 hr.	Gross infection, skin loss, non-union	36	Although patient now has full-thickness skin coverage after numerous operative procedures, non-union is still present
Closed oblique	Dec. 18, 1951	4 hr.	Gross infection, broken plate, non-union	12	Still under active treatment for non-union
Open transverse	Dec. 29, 1951	4 hr.	Gross infection, skin loss, non-union	11	Continues to exhibit drainage in spite of sequestrectomies; will need considerable operative work in the future

Table 1 represents a compilation of the pertinent facts relative to the eleven cases of tibial plating. Lack of space necessitates the omission of seven of the cases shown when the paper was presented.

CASE REPORTS

Patient L. C. sustained an open comminuted fracture of the left tibia on May 7, 1950. He was hospitalized in a civilian hospital where an immediate open reduction with plating was performed. The operative wound did not heal and on July 7th two months following the original operative procedure, the plate was removed because of copious drainage. Figure 1A shows the condition of the left tibia on July 6th. There was non-union and in April, 1951, an autogenous bone graft was performed with wiring of the tibial fragments. The infection recurred, necessitating removal of the wires and a portion of the necrotic bone graft. Subsequently the patient underwent several sequestrectomies. He was admitted to our service on January 14, 1952, and Figure 1B reveals the condition of the tibia nineteen months following the original injury. On conservative therapy the wound failed to close and several sequestra extruded themselves. On March 21, 1952, two years after the original injury, a below-knee amputation was performed and by August, 1952, the patient was fully ambulatory on his prosthesis with no complaints.

Patient R. C. sustained a closed comminuted fracture of the right tibia on November 14, 1948. He was hospitalized in a civilian hospital immediately following the injury. Figure 2A reveals the original condition of the fracture. The patient was treated for approximately six weeks by skeletal traction utilizing a wire through the os calcis. On December 23rd open reduction and plating were performed. The operative wound did not heal and exhibited moderate drainage. The patient was immobilized in a long-leg cast for thirteen months fol-



1A 1B

FIG. 1. Patient L. C. A, left tibia following open fracture and plating, July 6, 1950; B, condition of left tibia following eighteen months of treatment and just subsequent to amputation.

FIG. 2A. Patient R. C. Preoperative x-rays of the right tibia following injury.

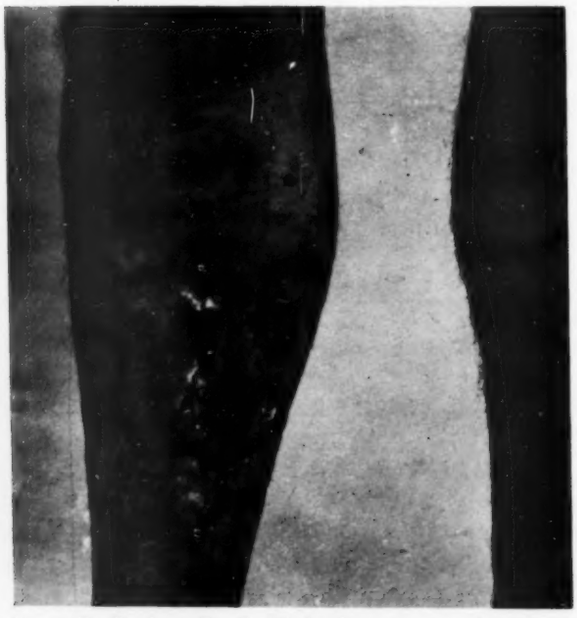
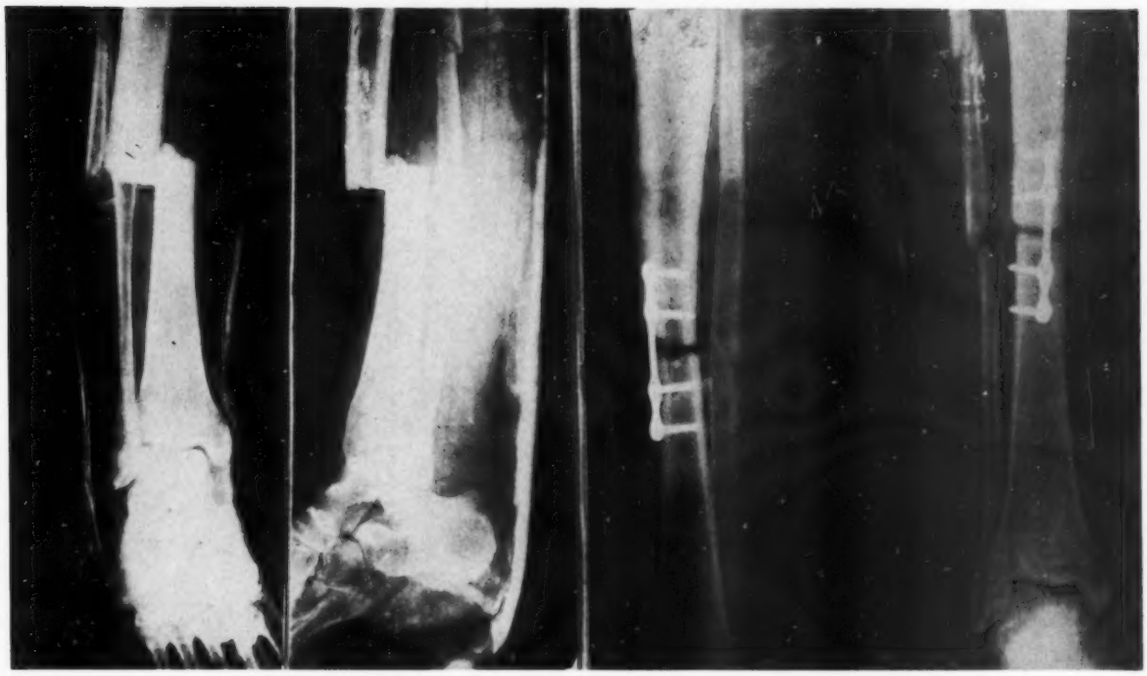


FIG. 2B. Patient R. C. Right lower extremity three years and eight months following original injury. Note persistent sinuses.

lowing his original surgery and at some period during this immobilization the plate was removed because of purulent drainage at the operative site. During the Spring of 1950 he underwent a sequestrectomy but without subsequent healing. The drainage continued. He was admitted to our service on August 6, 1952, three years and eight months following the original injury. Examination of the tibia revealed evidence of stability but the operative site revealed marked purulent drainage. Figure 2B reveals the condition of the right leg on admission. On August 19, 1952, a sequestrectomy was performed. The patient was discharged on October 24, 1952, three years and eleven months following his initial injury, at



3A 3B

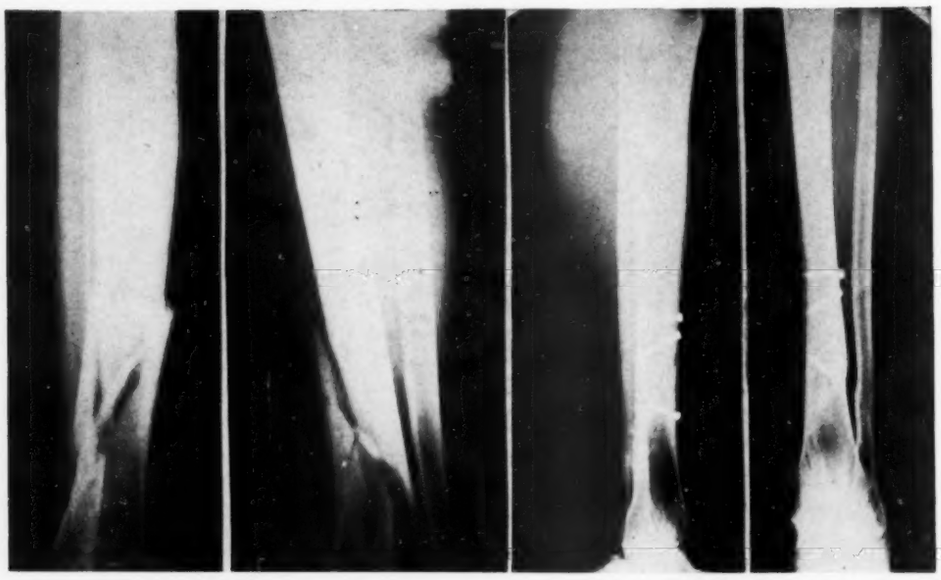
FIG. 3. Patient H. M. A, preoperative x-ray of right tibia immediately following injury; B, condition of tibia three months postoperatively, with obvious distraction and non-union at the fracture site.

FIG. 4A. Patient I. S. M. X-rays taken six months following original injury, revealing obvious distraction of the fracture fragments by a three-hole forearm plate.

FIG. 4B. Patient I. S. M. Reveals the condition of the right lower leg ten months following the original injury.

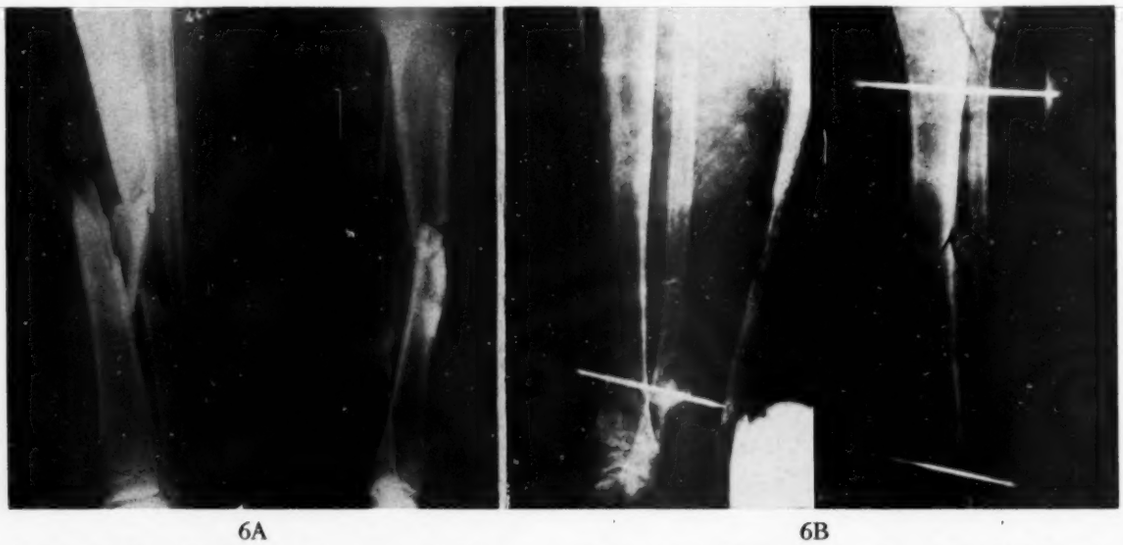
which time the operative wound was granulating in rapidly. Subsequently, it is planned to do a cross leg pedicle flap procedure.

Patient H. M. sustained an open transverse fracture of the right tibia on May 10, 1951. He was taken immediately to a civilian hospital. Figure 3A shows the condition of the tibia immediately following the injury. On the day of admission his wound of compounding was débrided and the fracture fragments fixed by a four-hole Lane plate and screws. The operative wound did not heal and purulent



5A 5B

FIG. 5. Patient W. H. A, x-rays of closed oblique fracture taken immediately following injury; B, reveals the condition of the right tibia fourteen months following initial injury.



6A 6B

FIG. 6. Patient W. C. W. A, x-rays of oblique comminuted open fracture taken immediately following injury; B, immediate postoperative x-rays showing the fracture held in excellent alignment by the two-pin method.

drainage began. Figure 3B shows the condition of the tibia in August, 1951, subsequent to which the internal fixation device was removed. Following this the operative wound slowly granulated in and drainage ceased. Treatment consisted of immobilization of the extremity in a long-leg plaster cast. Ten months following the original injury there was non-union both clinically and roentgenologically.

Patient I. S. M. sustained an open transverse fracture of the middle third of the right tibia and fibula on December 29, 1951. He was hospitalized in a civilian hospital where he subsequently underwent open reduction and plating. The operative wound failed to heal and a portion of the overlying skin sloughed, with purulent drainage exuding from the fracture site. Figure 4A shows the result six months following the original injury. On June 2, 1952, the plate was removed and the skin defect covered with a split-thickness graft. A partial take ensued with considerable diminution of

7A 7B

FIG. 7. Patient J. C. S. A, x-rays of a closed oblique comminuted fracture taken immediately after injury; B, reveals the condition of the right tibia at the sixth month following treatment by the two-pin method.

drainage, but by October, 1952, it was thought that a definite sequestrum was present. Figure 4B shows the condition of the leg at that time. On October 10, 1952, ten months following injury, sequestrectomy was performed following which the patient was immobilized in a long-leg plaster-of-paris cast.

Comments

In view of the opinion of the authors that tibial shaft fractures may well be treated by methods other than plating, presentation of our methods and results is felt to be justifiable.

We shall present four cases which are believed to be representative of both our management and results of tibial shaft fractures. Preliminary to this it is thought that a few remarks of a general nature on our management of the various types of tibial fractures might be indicated.

Closed transverse fractures are treated by manipulative reduction under spinal anesthesia, the knee being flexed to 90 degrees over the end of the operating table. Following the manual reduction, the leg is encased in a plaster cylinder which is allowed to harden. The knee is then brought into extension and the thigh and foot are incorporated in the cast.

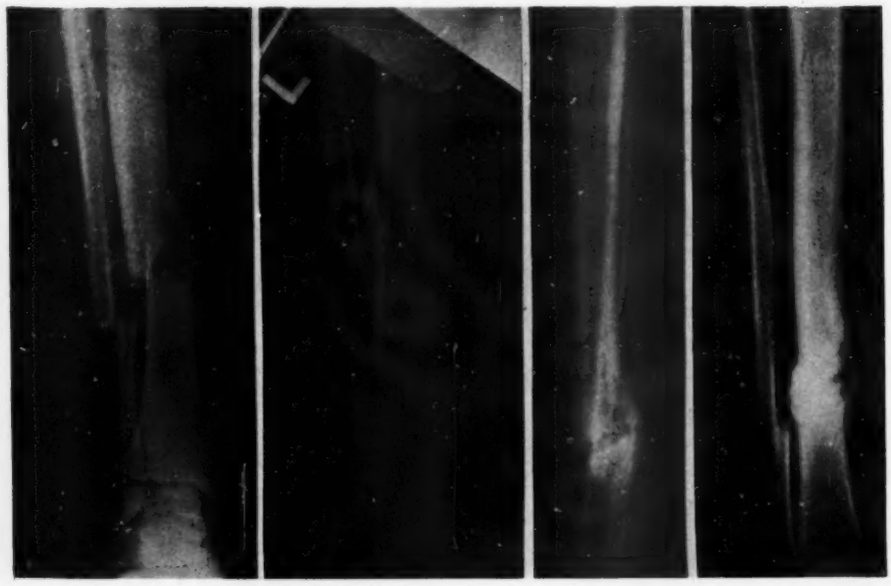
Closed oblique fractures are treated by open reduction and fixation by two or more screws.

Closed comminuted fractures and all open fractures are reduced by traction on the Albee-Compere table. Steinmann pins are then inserted above and below the fracture site and the leg is encased in a plaster cylinder incorporating the two pins. When this has hardened, all traction is removed and the foot and thigh are incorporated in the cast. If the alignment is not acceptable, wedging of the cast is performed until the alignment is satisfactory in all planes.

Presentation of Authors' Cases

Patient W. H. sustained a closed oblique fracture of the right tibia and fibula on October 9, 1951. Figure 5A shows the anteroposterior and lateral views, respectively, of the fracture at the time of admission to our service. The patient was taken to surgery within two hours following the injury and the fracture was openly reduced and fixation accomplished using three stainless steel screws. Full weight-bearing was begun at the fifth month. Figure 5B illustrates the result fourteen months following the initial injury.

Patient W. C. W. sustained an open comminuted fracture of the right tibia on July 26,



8A 8B

FIG. 8. Patient W. G. S. A, x-rays taken immediately following the injury reveal a transverse slightly comminuted fracture of the left tibia; B, reveals the amount of union present at the end of the sixth month following treatment by manipulation and plaster.

1952. He was admitted directly to our service and Figure 6A shows the condition of the right tibia immediately following his admission. Four hours following the accident débridement and open reduction were performed and the fracture stabilized by the utilization of two Steinmann pins placed above and below the fracture, the pins being incorporated in a long-leg cast. Figure 6B shows the result immediately after operation. By August 10th, two weeks following the original injury, the wound of compounding was completely healed. On October 21st the Steinmann pins were removed. The patient was fully ambulatory without support at five months and was returned to full duty at the end of six months with no complaints referable to the right lower extremity.

Patient J. C. S. sustained a closed oblique comminuted fracture of the right tibia on March 29, 1952. Figure 7A shows the condition of the tibia immediately following the injury. The patient was seen here primarily, but because of other complications primary reduction was postponed until April 9, 1952, when under spinal anesthesia a closed reduction with two-pin fixation was accomplished. This initial cast was wedged on April 26th. Progress was entirely satisfactory and on July 5th the Steinmann pins were removed and a long-leg cast applied. On September 2nd, five months after injury, ambulation was begun. Figure 7B shows the condition of the tibia six months post-injury. The patient was returned to full duty on October 29th, seven months after the original injury.

Patient W. G. S. sustained a closed, nearly transverse, comminuted fracture of the tibial shaft on May 31, 1951. He was admitted directly to our service. Figure 8A reveals the condition of the tibia immediately following the injury. The patient was treated with manipulative reduction and casting. Wedging of the plaster was subsequently performed to improve the alignment. Healing was satisfactory. Figure 8B reveals the condition of the tibia six months following original injury, at which time the patient was discharged to full duty.

With regard to our results, of the 139 tibial shaft fractures seen during the period covered by this report, sixty-eight were treated primarily by our staff. In none of these cases was plating deemed necessary or advisable. Of this group there were no malunions, no infections, no non-unions and only two cases of delayed union, both of which were clinically and roentgenologically solid at the end of one year postinjury. One case was a severely comminuted closed mid-shaft fracture treated by the two pin–cast method, and the other an

oblique closed fracture of the distal one-third of the tibia treated by open reduction and screw fixation.

CONCLUSIONS

Despite recent advances in chemotherapy, metallurgy and antibiotic agents, serious and debilitating complications still plague those who indulge in indiscriminate plating of tibial shaft fractures.

In the opinion of the authors, a great need exists for re-evaluation of the indications and technic for plating of these fractures. This is not the innocuous procedure that many surgeons have been led to believe. Plating of tibial shaft fractures should be reserved for those individuals who have been thoroughly indoctrinated in the basic principles and technic as expounded by Lane and Murray.

SUMMARY

A brief résumé of the fundamental work and recent significant developments with regard to plating of tibial shaft fractures has been presented. Eleven cases of open and closed fractures of the tibial shaft have been presented in which complications subsequently developed. These cases have been selected for presentation because it was believed that their complications were directly attributable to plating.

Four cases covering the major types of tibial shaft fractures treated conservatively have been presented to illustrate the authors' method of treatment.

REFERENCES

1. Carpenter, E. B., Dobbie, J. J., Siewers, G. F. Fractures of the shaft of the tibia and fibula. *Arch. Surg.*, 64: 443–456, 1952.
2. Davis, A. G. and Fortune, C. W. Fractures, compound. *J. Bone & Joint Surg.*, 25: 97–120, 1943.
3. Davis, A. G. Primary closure of compound fracture wounds. *J. Bone & Joint Surg.*, 30A: 405–415, 1948.
4. Editorial Biography of Sir Wm. Arbuthnot Lane. *J. Bone & Joint Surg.*, 34B: 478–482, 1952.
5. Hudack, S. S. Fractures of the tibia in adults. *J. Bone & Joint Surg.*, 23: 896–902, 1941.
6. Key, J. A. et al. Closed reduction, plate fixation and medullary nailing of fractures of both bones of the leg. *J. Bone & Joint Surg.*, 34A: 861–877, 1952.
7. Lane, W. A. The use of plates and screws in the operative treatment of fractures. *Practitioner*, 85: 610–636, 1910.
8. Lane, W. A. The Operative Treatment of Fractures. London, 1914. London Medical Publishing Co.
9. Mansfield, R. D. The treatment of oblique spiral fractures of both bones of the leg. *J. Bone & Joint Surg.*, 23: 910–916, 1941.
10. McLaughlin, H. L. et al. Open reduction and internal fixation of fractures of the long bones. *J. Bone & Joint Surg.*, 31A: 94–99, 1949.
11. Murray, C. R. The timing of the fracture healing process. *J. Bone & Joint Surg.*, 23: 598–603, 1941.
12. Murray, C. R. The detailed operative technique for open reduction and internal fixation of fractures of the long bones. *J. Bone & Joint Surg.*, 26: 307–312, 1944.

THE PROBLEM OF RADICAL BREAST SURGERY

THOMAS C. CASE, M.D.
New York, New York

THE purpose of this discussion is to examine, from a critical point of view, the concepts of the treatment of carcinoma of the breast as they are currently understood, to consider the validity in the methods employed for cure and palliation, and to inquire into what may be done or considered in order that the generally unsatisfactory status of the management of the disease may perhaps be improved. The present generation of physicians has witnessed greater advances in medicine than have occurred in any previous corresponding period, but few indeed are the really significant additions to the management of cancer of the breast in spite of an improved knowledge about the disease and its mode of dissemination.

Clement of the Alexandrian school centuries ago made the observation that "the beginning of truth is to wonder at things." The present situation in regard to the treatment of cancer of the breast is far from satisfactory and many thoughtful surgeons have wondered and still wonder whether or not the radical surgery of today in the treatment of breast cancer is justified. As noted by Graham, "It is a strange paradox that while the pendulum of thought has swung to the point of extreme radicalness in the removal of more and more tissue in an attempt to cure cancer surgically, in the case of cancer of the breast there is, with but few exceptions, an increasing conservation. This conservatism has been produced in great measure by the realization that in the presence of certain physical findings it will be impossible to circumscribe the tumor by radical surgery."

The inadequacy of the currently accepted radical mastectomy in many cases has stimulated efforts to secure better results by an extension of the magnitude of the operative attack. Such extension has been made possible with the development of supportive measures such as the free use of whole blood transfusions, the increased safety of prolonged anesthesia and the improved understanding of blood chemistry. This combination of a desire for better results and the possibility of executing more radical procedures has resulted in the accomplishment of drastic destructive operations that would have been held impossible a few years ago. The fact that the radical operation can now be performed without undue mortality does not in itself justify the indiscriminate use of the operation when more conservative measures are equally successful, in the properly selected cases.

PERCENTAGE OF WOMEN ELIGIBLE FOR ANY OPERATION WITH THE HOPE FOR A CURE

Approximately one-third of all cancer deaths in women are due to cancer of the breast. The number of "nearly 50,000 cases every year" used by the American Cancer Society in their figures is surely sufficiently impressive. It is important, therefore, that the physician who first sees a patient with tumor of the breast be acutely conscious of his responsibility of advising the patient properly. There are several things that contribute to regretful delay. First, women have inordinate pride in their breasts and become horrified at the thought of having them multilated. Physicians who recommend boldly other more serious surgical procedures become timorous and circumspect when it is necessary to suggest amputation of a breast. As a result of this, according to Lynham, 75 to 95 per cent of all patients who present themselves for treatment have spread of their disease beyond the breast tissue. McNealy reported that only 15 per cent of patients who apply for treatment at Cook County Hospital in Chicago are true stage 1 patients. Portman states that 80 per cent of patients who present themselves for treatment have axillary involvement and that only 20 per cent could therefore be considered in stage 1; also, of that 20 per cent approximately 15 per cent die within five years of cancer because the disease had spread at the time of operation beyond areas of detection. We are therefore left with only 17 of the 100 cases in which the disease is confined to breast tissue and in which we can

expect a cure. McWhirter's analysis of the situation is shown in Table 1.

It will be noted that in Table 1 there are only fifteen cases which could be considered true stage 1 cases with the disease confined to breast tissue and in which the simpler procedure with postoperative radiation should be adequate therapy. There is then a group of seventeen patients in whom the procedure of choice is in dispute. If radical mastectomy is performed in this group, it must not be assumed that the operation would be successful in all cases. If it were, the five-year survival rate of all operable cases with histologically positive nodes would be well over 50 per cent. The usual figure in the literature is 35 per cent and in subsequent years it deteriorates still further; so that in effect when we speak of treatment for carcinoma of the breast for cure, we can consider only a relatively small number of the patients who present themselves. It seems to me that perhaps more attention should be directed to early diagnosis, for it has been estimated that approximately 70 per cent of women may be dead within five years from the time when they were first seen. Management of tumor of the breast should then start the day it is found if we expect to have a larger group of women as candidates for any operative procedure and expect a cure.

TABLE 1
MCWHIRTER'S ANALYSIS OF 1,606 CASES

Operable			Locally Advanced	Distant Metastasis
56 %			29 %	15 %
Axillary Glands Histologically negative	Axillary Glands Histologically positive			
40 % of operable cases; 22 % of total cases	60 % of operable cases; 34 % of total cases			
Approximately 33 % of these will prove positive if serial sections are done	Glandular involvement confined to axilla 17 %	Positive supraclavicular and internal mammary 17 %		
Simple mastectomy as effective	Disputed group	Radical mastectomy fails	Radical mastectomy does not apply	

RADICAL MASTECTOMY

A host of operations varying greatly in extent and completeness have been termed radical operations. In most part they are considered radical when they include dissection of the axilla with removal of the pectoral muscles, breast tissue and its tumor *en bloc*. This is approximately what Halsted described as the radical operation for cancer of the breast in 1894. Indeed, it was not too long after the procedure became established that even Halsted himself appeared to be somewhat uncertain as to what exactly was the procedure which should bear his name. At one time Halsted did not remove all of the pectoralis minor; at another he removed the supraclavicular nodes; still later he removed part of the chest wall. In 1907 he advised stripping the fascia from the upper part of the rectus abdominis, the subscapular and at times the latissimus dorsi. He speculated that the removal of the shoulder joint might eradicate metastasis to bone. In 1913 he stated that he had discontinued the incision out on the arm and advised instead a vertical incision extending up toward the clavicle. He also stated that he thought it would be likely in the near future to remove the mediastinal contents at some of the primary operations. The early experiences with the more radical approach seem not to have been continued, however, since later communications from the Johns Hopkins Hospital reveal fewer supraclavicular nodal dissections and no further reference to anterior mediastinal operations. This I believe was the result of the realization that the removal of cancerous tissue cannot be reduced to what has been described as "plucking the blueberries out of a muffin."

There have been no important improvements in the technic of this operation since then. While the procedure appears to be standardized, there is still a considerable amount of confusion about it. Accordingly, we find some clinics that question the validity of wide skin excision while others advise excision of skin wide enough to require grafting. In fact the trend is to employ even more extensive procedures, with certain clinics considering the following: (1) extending the classical procedure

to include nodes at the base of the neck; (2) removal of nodes along the internal mammary chain; (3) removal of clavicle for better exposure; (4) removal of ribs involved in the disease; (5) routine removal of axillary vein; (6) dissection of components of brachial plexus; and (7) Interscapulothoracic amputation sweeping off the neck and axillary nodes.

In deciding just where to limit surgery, two problems arise: First is the difficulty of deciding at what stage in the extension of the procedure the possible added salvage obtained from more extensive resection of lymphatic draining area begins to be negated by increased operative morbidity, mortality and postoperative discomfort and disability. Second, at what stage in the progression of regional lymphatic extension from cancer of the breast does the disease become generalized and beyond the scope of surgical extirpation?

If we are to be consistent in our radicalism we should then carry out these radical procedures in *all* cases and also perhaps attempt some form of mediastinal exploration as suggested by Gordon-Taylor in 1948.

Would this then assure us of a cure? Knowing the great variation in the rate of growth of cancer of the breast and the difficulty in appraising the results, one cannot deny that extreme radical surgery may produce needless morbidity and suffering.

THE BASIS FOR RADICAL SURGERY OF THE BREAST

When a surgical procedure has been passively accepted for more than fifty years and has become ingrained in the medical mind, it is obviously difficult to uproot it on presumptive evidence alone, even though the original was based on presumptive evidence.

The belief is widely accepted today that surgical therapy is the only modality of treatment which offers any hope of cure in operable cases of carcinoma of the breast. The rationale of the surgical treatment of this disease and its spread is naturally based on knowledge of the pathways for propagation of the lesion. While Handley's theory of continuous lymphatic spread (permeation) to distant points in the organism is in a way too dogmatic, since it disregards lymphatic embolism and venous propagation, it nevertheless placed the operative treatment of cancer of the breast on a rational, i.e., anatomic basis. It prepared the scientific foundation for radical surgical therapy which was developed previously by Halsted on an empiric basis. Halsted's operation exemplified the fact that cancer can be cured even after it has spread from its primary focus to its regional axillary nodes *if* the disease was limited to that point.

The principal lymphatic drainage of the breast, i.e., the cutaneous and parenchymal lymphatics, passes from its subareolar plexus to the pectoral, central and apical nodes of the axilla and from there, with or without interposition of supraclavicular nodes, into the thoracic duct on the left or right lymphatic duct. However, deviations from this basic arrangement frequently occur, consisting in short-cuts which may by-pass one, two or even three of the relay stations mentioned. Therefore, direct lymph drainage from the breast into the central, apical, subclavicular or supraclavicular glands may occur. In the latter instance one has the clinical picture of involved supraclavicular nodes without involvement of the axilla, a condition generally regarded as inoperable.

Another clinically important point is the presence of lymphatic spread through atypical channels after blockage of the usual lymphatic pathways. This is exemplified by the occasional involvement of the inguinal lymph nodes. Of great importance are pathways from the medial half of the breast to the other breast, to the other axilla and to the internal mammary nodes and mediastinal nodes. Spread to these locations usually precludes the possibility of surgical cure. The pleura and peritoneum are within reach of direct lymphatic involvement, the pleura by communications with the lymphatics of the pectoral and intercostal muscles, and the peritoneum by way of lymphatics from the inferior and medial segments of the breast that anastomose through the linea alba with subperitoneal lymph plexuses. (Fig. 1.)

Another important practical point one must keep in mind is that the axillary, supraclavicular and internal mammary or mediastinal nodes are, in effect, one continuous chain and that involvement of any one group would in most cases make one suspicious of involvement of the others. This involvement may not be macroscopic or clinically detectable. However, the process may well be present in its microscopic stage or in the pathologic biologic cellular alteration that initiates cancer growth.

Extension of the growth to the pectoral fascia is also of considerable significance. Heidenhaim found cancerous lymphatics running from the breast to the pectoral fascia in twelve of eighteen patients examined. It has also been found that cancerous lymphatics may be present in the pectoral fascia before the growth has become adherent to the muscle or skin. There is thus strong evidence that fascial permeation begins a considerable time before the case ceases to be operable. Although in certain cases the spread of permeation is slow and limited, it appears equally certain that in other cases, still within the operable category, the circle of permeation at the time of operation will already have attained a considerable diameter.

The surgical principle involved in attack on cancer may be stated simply as the removal of the primary disease and all the tissue in continuity with it to the farthest limit of its spread, consistent with survival of the patient and the preservation of a reasonably tolerable state of health and comfort after recovery.

Radical mastectomy is based chiefly on the presence of a direct lymphatic spread from the lesion on to the superior portions of the breast along the pectoral fascia to the axillary nodes, through the substance or along the deep surface of the muscles. From the rather brief descriptions of the complicated and varied lymphatic spread of carcinoma of the breast it appears quite obvious that all lesions do *not* progress in one direction, and that with the most honest and aggressive radical approach one is never sure of complete eradication of the disease unless surgical treatment is employed when the disease process *is in a very early stage* and the pathologic tissue is limited to the breast. In such an early stage of the disease extensive radical procedures would not be indicated.

During recent years all surgeons have been impressed by the increasing interest in the extension of the radical procedures. Emphasis has been placed on the extirpation of nodes, and radical procedures have been extended to include dissection of supraclavicular nodes, internal mammary nodes and even mediastinal exploration. These efforts have been the result of the belief that the employment of such extensive procedures would result in a cure, because in the presence of unrecognized involvement of these nodes the ordinary radical mastectomy is, of course, inadequate. A comprehensive increase in the extent of the operation cannot be expected to bring commensurate improvement in the morbidity and mortality statistics if one remembers the varied and unpredictable lymphatic spread of this disease. To quote Handley, Sr., "Unfortunately the

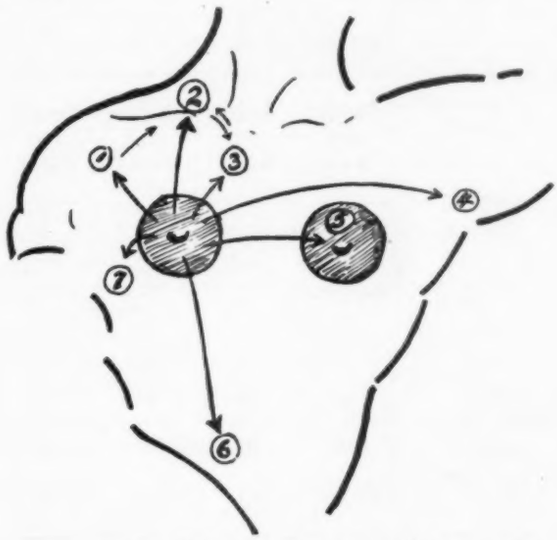


FIG. 1. Routes of lymphatic spread. (1) 60 per cent of operable cases have positive axillary nodes; (2) 33 per cent of these have supraclavicular nodes involved; (3) 46 per cent of the operable cases with axillary nodes have internal mammary node involvement; (4) spread to opposite axilla (5 per cent of cases with medial lesions); (5) spread to opposite breast (5 per cent of cases); (6) spread into abdomen; (7) spread directly into chest.

microscopic growing edge of the carcinoma is not clinically recognizable, and the surgeon cannot determine for each case as it comes before him how far the circle of fascial permeation has extended." Handley, Jr., whose original work on the internal mammary chain of nodes was intended as an investigative procedure rather than a therapeutic measure, concluded "that while excision of the internal mammary chain *in toto* was surgically feasible it would add very greatly to the operative mortality without a guarantee of compensatory benefit."

I would also like to quote the observation of Jaffee, who stated that "A tumor of less than one centimeter in diameter is most difficult to palpate in the breast and a tumor of that size has approximately 10 million cells within its boundaries. One can imagine the cellular activity which has taken place during the growth and reproduction of this number of cells. How long does it take for the growth of 10 million cells? How old is a tumor which is one

centimeter in diameter? The size of a tumor is no criterion of its age and still less a measure of its malignancy. How long is it before cells leave the parent tumor and drift away in the lymphatic or blood stream? What part of the cells that escape the confines of the parent tumor are

TABLE II
MCWHIRTER

Stage of Disease	Radical and X-ray	Simple and X-ray	Radical and X-ray	Simple and X-ray
	Absolute 5-Year Survival (%)	5-Year (%)	10-Year (%)	10-Year (%)
Operable	48	58	31	41
Locally advanced	18	29	7	12
Distant metastasis	2	4	0	0

arrested in the neighboring lymph nodes, and how many drift farther and either die in transit or live to lodge in some distant organ? These are only a few questions which harass the surgeon who must decide what is best for the patient with a breast cancer."

It seems to me, in view of our improved knowledge of the lymphatic drainage of the breast, that the basis upon which radical mastectomy was first done is not quite as well founded today.

COMPARISON OF STATISTICAL ANALYSIS REPORTS

The average statistical reports of leading clinics in the United States using radical mastectomy is as follows: five-year survivals, stage I, approximately 75 per cent; five-year survivals, stage II, approximately 28 per cent; five-year survivals with all stages considered, approximately 30 per cent.

One must keep in mind that the average of 75 per cent five-year survivals is in the very carefully selected small group of patients in whom the disease is supposedly limited to the breast. The radical procedure is therefore a rather inadequate method of treating cancer of the breast when one considers the small percentage of the total cases to which it can be applied.

The superradical procedure was recently evolved by Wangensteen because it has been found that 61 per cent of patients who were operated upon with a radical mastectomy according to the criteria of operability were found to have involved nodes in the supraclavicular or internal mammary chain. These findings usually preclude the possibility of a cure by any surgical procedure. However, the radical procedure was nevertheless extended to include dissection of both the supraclavicular and mediastinal regions with a postoperative mortality of 13 per cent and a postoperative morbidity far greater than with any other procedure. These results are most discouraging and I do not believe the use of the procedure will be continued.

In the more recent years several groups both here and abroad have revived the more simple procedures and the use of postoperative radiation for the treatment of mammary cancer; the results both immediate and late have been most gratifying. I use the word revive because I can remember when the simple mastectomy was used by competent surgeons in this city twenty-five years ago and the results could not have been too bad for they continued the practice until they retired from the profession.

McWhirter has aroused considerable interest and no little controversy more recently by recommending simple mastectomy to be followed with x-ray therapy. His idea is that if the axilla is not involved, there is no need for axillary dissections; and if the axillary nodes are involved, removal of this natural barrier added to the operative trauma may well cause dissemination of cancer cells to distant sites. His views are so contrary to the teaching in the United States that everyone hesitates even to consider adoption of this course of treatment without further proof that it is the procedure of choice. His five- and ten-year survival rates are, however, quite impressive. (Table II.)

In selecting patients for the different stages no account was taken of factors other than the apparent extent of the disease as determined clinically. Thus no account had been taken of the patients' age, general health or even of pregnancy and lactation.

Orr introduced and used a procedure called the subradical mastectomy, in which the breast, the axillary contents and the pectoralis minor muscle are removed, the pectoralis major being

left intact. Most of the patients received postoperative radiation. His five-year and ten-year results were much better than those for patients treated with radical mastectomy. (Table III.)

Deaton and Bradshaw, in a recent report of eighty-four patients with microscopically proved cancer of the breast, noted that of the patients treated by radical mastectomy (fifty-four) there was a five-year survival rate of 81.2 per cent for stage I, 48.4 per cent for stage II and 0 for stage III; of course, none of stage IV were treated by surgery. Of the thirty patients treated by simple mastectomy and postoperative irradiation the five-year survival rate was 91.6 per cent for stage I, 77 per cent for stage II, and 16.7 per cent for stage III. These results indicate that the simpler procedure offered the better prognosis. (Table IV.)

TABLE III
ORR STATISTICS

Procedure	Group	No.	Alive 5–9 Years (%)	Alive 10–19 Years (%)
Radical operation	I	77	64.9	24.6
	II	89	26.9	8.9
	III	29	0	0
Subradical operation	I	46	85	25
	II	30	41.6	0
	III	0	0	0
Simple mastectomy	I	13	61	15.3
	II	2	0	0
	III	29	0	0

TABLE IV
DEATON AND BRADSHAW
5-Year Survival

Procedure	Stage I (%)	Stage II (%)	Stage III (%)
Radical	81	48	0
Simple and radiation	91.6	77	16.7

Bell, in reporting a group of fourteen cases (stage III) in which simple mastectomy plus postoperative roentgen therapy was employed, revealed that 21.4 per cent of the patients were living and well five years later, as compared with 16.6 per cent of patients treated by radical operation alone. (Table V.) He expressed the opinion that irradiation was responsible for the larger percentage of five-year survivals and stated: "If a greater number of cases were represented, this might point more toward confirmation of McWhirter's ideas."

I believe the criteria of operability proposed by Portman and Haaggensen in 1943 did more to establish some degree of standardization of cases for surgical approach than anything else in the literature. When the criteria are analyzed, they in fact reduce the operable cases to a small group of patients. In a series of cases reported by Haagensen were a small group of patients on whom he had used simple mastectomy and axillary dissection, and his five-year survival rate was 69.5 per cent in those cases.

TABLE V
BELL FIGURES ON RX OF 203 ADVANCED CASES

Procedure	No.	Living and Well Five Years (%)
Radical surgery alone	12	16.6
Radical surgery and preoperative radiation	15	20
Radical surgery and postoperative radiation	16	18.7
Radiation alone	103	2.91
Simple mastectomy Postoperative radiation	14	21.4*

* Confirms McWhirter.

In addition to the above McNealy, of Chicago, has been an advocate of the simpler procedures for a long time and Prudente, of Brazil has recently reported gratifying results by the use of simple mastectomy with removal of pectoralis fascia and postoperative radiation. At one of the Municipal Hospitals and in my private work, we have been using the so-called extended simple mastectomy and postoperative radiation on a small group for the past four years. It is my belief that the extended simple mastectomy could be employed in all cases of stage I and stage II; and that if the general condition of the patient warrants any surgical intervention, the procedure could be applied to patients with tumors in stage III. The benefit of the simpler procedure in stage III has been indicated by the reports of Bell and McWhirter. The decision to operate in cases of stage III cancer is a matter of experience and judgment. No arbitrary set of rules can be set forth and adhered to; flexibility is a necessity. The justification for this lies in the fact that patients

who were considered to have a hopeless prognosis have been operated on and thereafter have enjoyed many comfortable years of life.

The extended simple mastectomy is performed with the intention of effecting a cure in the early stages and for palliation and possible cure in the more advanced stages. It consists of removal of the mammary gland with the lesion and the overlying skin, including the nipple and areola; an extensive area of pectoral fascia extending up into the axilla and all accessible axillary nodes with the fat pad. The axillary dissection is performed because carcinoma of the breast as a rule metastasizes into the base of the axilla, especially if the lesion is in an outer quadrant. Removal of the involved nodes may be beneficial for two reasons: (1) the disease may be limited to the nodes removed and (2) in addition to the removal of the primary focus by simple mastectomy one may be removing a lesion in the involved nodes which might otherwise continue to act as a primary focus for further dissemination of the disease. Removal of axillary fat pad makes x-ray therapy more effective.

The fascia overlying the pectoralis major, together with the surrounding fascia, is removed because of its intimate relation to the lymphatic system of both the breast and the axilla. Since there are no satisfactory clinical means of fixing the limit of fascial extension, the only safe rule is to remove a very wide area of the deep fascia; this is an innocuous procedure and would probably be beneficial. If the tumor is fixed to muscle, the muscle should be removed with the breast. Any surgical procedure beyond that, in my opinion, would be futile.

Skin grafting should never be required if only the necessary amount of skin is removed. The work of Handley and the reports of Rodman have demonstrated that removal of large areas of skin is not indicated and that the recurrence rate is not increased with the removal of only the necessary amount of skin.

One of the many objections to the use of any procedure other than radical operation has been the point that one cuts across or through cancerous tissue, thereby causing dissemination of cancer cells. This appears to be a fallacy. When one considers the lymphatic spread of carcinoma of the breast and the fact that the microscopic growing edge of the disease is not clinically recognizable, it is difficult to conceive how any surgeon can determine the precise extent of surgical therapy in order to avoid cutting through *any* area that is not contaminated, at least by invasion of the lymphatic vessels. The only type of lesion with which one can be sure of not cutting across contaminated tissue is the very early stage I lesion; and in such a case if the tumor is a true localized curable carcinoma, the simple surgical procedure with adequate postoperative irradiation is sufficient therapy.

Surgeons are aware of the fact that several factors influence the prognosis: the age of the patient, the location of the tumor and the histopathologic picture; however, the postoperative mortality and morbidity rates are definitely decreased with the use of these simple procedures. There is less mutilation and deformity of the part as well as less edema and limitation of motion of the extremity. The operative wound heals more quickly and roentgen therapy can accordingly be applied without delay.

It may be admitted that the series of cases reported is small; but until a larger series of cases becomes available, the cumulative data from such small series must suffice for temporary evaluation of the simple procedure and roentgen therapy.

The value of roentgen therapy has also aroused much controversy. The efficacy of postoperative radiation must also be considered with an open mind and, indeed, favorably when one realizes that postoperative recurrences have been reduced and that the survival rates have been increased by as much as 10 per cent. Since radiotherapy is a method of choice in many other forms of cancer, it must be considered that this treatment can also destroy or at least inhibit the progress in the growth of cancer cells of the breast and along the lymphatic spread unobtainable by any surgical procedure.

Physicians generally agree that inoperable cases should be treated with irradiation. They recognize that palliation received through such treatment is usually beneficial and often amazingly effective. If good results are obtained with inoperable cases, there appears to be some inconsistency in reasoning that irradiation will not benefit the patient after operation. Even when sterilization is not accomplished, the malignant cells are incarcerated in dense connective tissue so that effective growth

restraint may be achieved for a long period of time. Although uniform positive statistical proof of benefit may be lacking, the knowledge that cancer cells are destroyed or devitalized by irradiation justifies such treatment.

The palliation obtained from the use of both estrogens and androgens is familiar to all. The more recent interest developed in the adrenals is also of considerable significance for it has been found that the adrenal cortex is known to be involved as an etiologic agent in the genesis of certain mammary tumors of mice. Huggins has found that some mammary carcinomas are hormone dependent tumors, that their activity is specifically supported by the adrenal cortex and that such tumors regress when the adrenal factor is eliminated.

Perhaps we have reached the peak of advances in the surgical treatment of cancer of the breast and further progress will be dependent entirely upon the discovery of etiologic factors or upon the discovery of biochemical methods for eradication of the disease.

SUMMARY

1. Only about 15 per cent of women who present themselves can really be considered true stage 1 or operable patients in whom we can expect a cure. There is then a group of only 17 per cent which can be considered as those in whom the procedure of choice is in dispute. These are not true stage 1 cases.

2. A careful consideration of the lymphatic spread of cancer of the breast will reveal that the basis upon which radical mastectomy is performed is not as sound as it was thought to be.

3. If the disease is limited to the breast tissue (true stage 1), the simple procedures with postoperative radiation should suffice; there should be no need for further extension of the surgical field. The simpler procedure can be applied to a larger number of patients with comparative satisfactory if not better end results.

4. As a consequence of the variability of the disease and in the recording of the diagnosis and its accuracy, considerable difficulty is encountered in assessing the result of a particular form of therapy on the basis of a statistical analysis of such records. The cumulative data of the simpler procedures are nevertheless impressive.

CONCLUSION

In closing may I repeat that not enough time has elapsed nor are there sufficiently well controlled cases to justify definite conclusions. Nevertheless the statistics presented by the numerous clinics indicate that the simple procedure must have some merit. To be prejudiced is to create another obstacle to clear discernment, and it is one difficult to be rid of inasmuch as it has so many roots, namely, fear, preconceived opinions, beliefs impounded in our minds as truths and obstinacy which forbids the admission of a mistake. These are some of its roots and there are others. On further consideration one might interpret the negative attitude toward the simple procedures more a lack of subconscious moral courage rather than willful resistance. The attitude surely is more the outcome of causes other than the want of knowledge. Final judgment concerning the true value of this form of therapy must be reserved for the future; however, it is only by maintaining an open mind that we can help in combating this disease, accepting the risks which are the inevitable concomitant of all human progress.

My trust is that surgeons in the future will use many beacons to guide them. I am conscious that my enumeration of objections to the procedure of choice, radical mastectomy, may be lacking convincing completion. But the catalogue of errors is a lengthy one; and to mention all and moralize on each would be tedious and wearisome. All I hope to accomplish is to arouse and fertilize the imaginations of those who care to maintain an open mind, and should anything that has been said bear the appearance of arrogance, may I confess that it has arisen from a sorrowful contemplation of the surgical errors which I myself have committed in the treatment of this dreadful disease. As McWhirter recently stated "let our goal be better results in treating breast cancer and not just higher survival rates in treated cases."

REFERENCES

1. Brooks, B. and Daniel, A., Jr. Present status of "radical operation" for carcinoma of breast. *Ann. Surg.*, 111: 688, 1940.
2. Fitzwilliams, D. C. L. Plea for a more local operation in really early breast carcinoma. *Brit. M. J.*, 2: 405, 1940.
3. Grace, E. J. Simple mastectomy in cancer of breast. *Am. J. Surg.*, 35: 512, 1939.

4. Byrd, B. F. Cancer of the breast in the advanced age groups. *Surgery*, 27: 3, 1950.
5. Hoopes, B. F. and McGraw, A. B. Halsted radical mastectomy. *Surgery*, 12: 892, 1942.
6. Rovenstine, E. A. Geriatrics anesthesia. *Geriatrics*, 1: 46, 1946.
7. Ross, D. E. Surgical treatment of carcinoma of breast. *Am. J. Surg.*, 58: 113, 1942.
8. deTarranowsky, G. Surgery of aged: indications and contraindications. *S. Clin. North America*, 20: 3, 1940.
9. White, C. J. Cancerous pre-cancerous lesions in aged: diagnosis and management. *S. Clin. North America*, 20: 117, 1940.
10. Haagensen, C. D. and Stout, A. P. Carcinoma of breast: criteria of operability. *Ann. Surg.*, 118: 1032, 1943.
11. Zeman, F. D. Practical problems in the care of the elderly patient. *New York State J. Med.*, p. 16, 1951.
12. Case, T. C. Carcinoma of breast: a comment on therapy. *Am. J. Surg.*, 80: 2, 1950.
13. Case, T. C. and Oppenheim, A. Carcinoma of breast. *Harlem Hosp. Bull.*, 111: 2, 1950.
14. McWhirter, R. Treatment of cancer of breast by simple mastectomy and roentgeno-therapy. *Arch. Surg.*, 59: 830–842, 1949.
15. Adair, F. E. et al. The use of estrogens and androgens in advanced mammary carcinoma. *J. A. M. A.*, 140: 15, 1949.
16. Adair, F. E. The slow course of a cancer of the breast in an elderly person. *Ann. Surg.*, 98: 446–448, 1933.
17. Case, T. C. The radical mastectomy. *J. Internat. Coll. Surgeons*, Sept., 1951.
18. Garland, L. H. et al. Roentgen and steroid hormone therapy in mammary cancer metastatic to bone. *J. A. M. A.*, 114: 12, 1950.
19. McCormick, E. J. Benign and malignant disease of the breast. *J. A. M. A.*, 146: 5, 1951.
20. Bell, G. H. Cancer of the breast. *Ann. Surg.*, 130: 3, 1949.
21. Park, W. W. and Lees, J. C. The absolute curability of cancer of breast. *Surg., Gynec. & Obst.*, 93: 2, 1951.
22. Garland, J. G. Cancer of the breast. *Am. J. Surg.*, 69: 17, 1945.
23. Handley, R. S. and Thackery, A. C. The internal mammary lymph chains in carcinoma of breast. *Lancet*, 2: 276–278, 1949.
24. Haagensen, C. D. and Stout, A. P. Carcinoma of breast. *Ann. Surg.*, 134: 2, 1951.
25. Gordon-Taylor, G. The treatment of cancer of the breast. *Proc. Roy. Soc. Med.*, 41: 118–120, 1948.
26. Saphir, O. and Aromin, G. D. Obscure axillary lymph node metastasis in carcinoma of breast. *Cancer*, 1: 238, 1948.
27. Monroe, C. W. Lymphatic spread of carcinoma of the breast. *Arch. Surg.*, 57: 479–486, 1948.
28. Portman, U. V. Cancer of breast. *J. A. M. A.*, 144: 7, 1950.
29. Tomlinson, W. L. and Eckert, C. T. "Categorically inoperable" carcinoma of the breast. *Ann. Surg.*, 130: 38, 1949.
30. Adair, F. E. Surgical problems involved in breast cancer. *Ann. Roy. Coll. Surgeons of England*, 4: 360–380, 1949.
31. Clemmesen, J. Cancer of breast: results from statistical research. *Brit. J. Radiol.*, 21: 583, 1948.
32. Scarff, R. W. Prognosis in cancer of the breast. *Brit. J. Radiol.*, 21: 594, 1948.
33. Dawson, E. K. Precancerous conditions of the breast. *Brit. J. Radiol.*, 21: 590, 1948.
34. Cade, S. Discussion of carcinoma of the breast. *Brit. J. Radiol.*, 21: 596, 1948.
35. Cade, S. Carcinoma of breast. *J. A. M. A.*, 138: 15, 1948.
36. Prudente, A. Present day criteria for the treatment of breast cancer. *Rev. brazil. cancerol.*, 1: 11, 1947.
37. Handley, S. W. Cancer of the Breast and Its Treatment. New York, 1922. Paul B. Hoeber, Inc.
38. Rodman, W. L. Disease of the Breast with Special Reference to Cancer. Philadelphia, 1908. Blakiston Co.
39. Cutler, M. and Buschke, F. Cancer: Its Diagnosis and Treatment. Philadelphia, 1939. W. B. Saunders Co.
40. Veal, J. R. Swelling of the arm following radical mastectomy. *J. A. M. A.*, 108: 1236–1241, 1937.
41. Neuhof, H. Excision of the axillary vein in the radical operation for cancer of the breast. *Ann. Surg.*, 108: 1, 1938.
42. Adair, F. E. and Herrmann, J. B. Unusual metastatic manifestations of breast carcinoma. *Surg., Gynec. & Obst.*, 83: 289–295, 1946.
43. Urban, J. A. and Adair, F. E. Sclerosing adenosis. *Cancer*, 2: 4, 1949.
44. Monroe, R. T. Disease in Old Age, pp. 326–327. Cambridge, 1951. Harvard University Press.
45. Lachman, E. Common and uncommon pathways in the spread of tumors and infections. *Surg., Gynec. & Obst.*, 85: 767–775, 1947.
46. Slaughter, D. P. and Peterson, L. W. Indications for simple mastectomy. *Surg., Gynec. & Obst.*, 85: 456–460, 1947.
47. Orr, T. G. An attempt to evaluate the radical and palliative treatment of breast carcinoma. *Surg., Gynec. & Obst.*, 90: 4, 1950.
48. Adair, F. E. Testosterone in the treatment of breast carcinoma. *M. Clin. North America*, 32: 18, 1948.
49. Bevan, A. D. Problem of tumors of the breast from standpoint of general practitioner and surgeon. *J. A. M. A.*, 95: 1311, 1930.
50. Haagensen, C. D. Carcinoma of the breast. *J. A. M. A.*, 138: 195, 279, 1948.
51. MacDonald, I. Resection of the axillary vein in radical mastectomy; its relation to the mechanism of lymphedema. *Cancer*, 1: 618, 1948.
52. McGraw, A. B. Radical mastectomy. *Arch. Surg.*, 55: 292, 1947.
53. Oliver, D. R. and Sugarbaker, E. D. The significance of skin recurrence following radical mastectomy. *Surg., Gynec. & Obst.*, 85: 360, 1947.
54. Pfahler, G. E. and Keefer, G. P. The object, the value, and the technique of pre-operative and postoperative x-ray treatment in carcinoma of the breast. *Surg., Gynec. & Obst.*, 85: 35, 1947.

55. Rodman, J. S. Skin removal in radical breast amputation. *Ann. Surg.*, 118: 604, 1943.
56. Saphir, O. and Amromin, G. D. Obscure axillary lymph-node metastasis in carcinoma of the breast. *Cancer*, 1: 238, 1948.
57. Simmons, C. C. Cancer of the breast: ten-year end-results. *Surg., Gynec. & Obst.*, 74: 763, 1942.
58. Trimble, I. R. Cancer of the breast. *Surg., Gynec. & Obst.*, 70: 82, 1940.
59. Warren, S. and Tompkins, V. N. Significance of the extent of axillary metastasis in carcinoma of the female breast. *Surg., Gynec. & Obst.*, 76: 327, 1943.
60. Deaton, W. R., Jr. and Bradshaw, H. H. Simple or radical mastectomy: analysis of cases. *South. M. J.*, 44: 993–1088, 1951.
61. Davis, H. H. and Neis, D. D. Distribution of lymph node metastasis in carcinoma of the breast. *Ann. Surg.*, 136: 604–608, 1952.
62. Grant, R. N., Tabah, E. J. and Adair, F. E. The surgical significance of the subareolar lymph plexus in cancer of the breast. *Surgery*, 33: 71–78, 1953.
63. Urban, J. A. Radical excision of the chest wall for mammary cancer. *Cancer*, 4: 1263–1285, 1951.
64. Urban, J. A. Radical mastectomy in continuity with en bloc resection of the internal mammary lymph node chain. *Cancer*, 5, 992–1008, 1952.
65. Lewis, J. F. Super-radical mastectomy. Paper presented at meeting of American College of Surgeons, New York, 1952.
66. Wangensteen, O. H. Discussion of paper by Taylor and Wallace. *Ann. Surg.*, 132: 839, 1951.
67. Huggins, C. and Dao, T. L. Adrenalectomy for mammary cancer. *Ann. Surg.*, 136: 595–602, 1952.
68. Case, T. C. Extended simple mastectomy for carcinoma of breast. *J. Internat. Coll. Surgeons*, 18: 26–31, 1952.
69. Grace, E. J. and Moitrier, W. Simple mastectomy with x-ray in treatment of cancer of breast. *New York State J. Med.*, 36: 701–704, 1936.
70. McWhirter, R. Simple mastectomy with x-ray therapy. Paper presented at meeting of American Cancer Society, Cincinnati, 1952.
71. McNealy, R. W. Simple mastectomy with and without x-ray therapy. Paper presented at meeting of American Cancer Society, Cincinnati, 1952.
72. Taylor, G. W. Radical mastectomy. Paper presented at meeting of American Cancer Society, Cincinnati, 1952.
73. Eckert, C. and Seaman, W. B. The palliative treatment of advanced mammary cancer. *S. Clin. North America*, 30: 1435–1445, 1950.

CARCINOMA OF THE BILIARY TRACT*

IRA S. GOLDENBERG, M.D.
New Haven, Connecticut

CARCINOMA of the biliary tract long has been a discouraging problem from the standpoint of early diagnosis, therapy and cure. The literature contains many series of patients with primary malignancy of the liver, gallbladder and extrahepatic bile ducts, but with only few early diagnoses and even fewer therapeutic successes.

Diagnosis early in the course of the disease, when it would be most amenable to surgical treatment, has not been possible. Mass screening methods for asymptomatic persons have not been devised and investigation of any case of necessity has followed the onset of clinical signs and symptoms. Lemon and Byrnes[24] employed duodenal drainage and cytologic examination of aspirations in an attempt to make a diagnosis before surgical intervention in cases of suspected biliary tract cancer. The method is sound and in sixteen cases of later proven carcinoma eleven patients were suspected or diagnosed as having cancer after examination of duodenal contents alone. Although these investigators state that examination of the cytologic smears is so simple that a second year medical student can identify malignant cells after a few hours' instruction, duodenal drainage hardly is a procedure suitable for routine application in asymptomatic patients as a screening procedure. It has been verified frequently that by the time symptoms are present in biliary tract cancer, therapy is seldom curative because the disease is so far advanced by that time. As in other types of cancer, it would appear that only with the development of rapid, simple diagnostic methods can early cases be discovered.

Despite the gloomy picture that carcinoma of the biliary tract presents, it is necessary from time to time for clinicians to report their experiences with the disease. Only by the analysis of this past experience can planning for the future be accomplished.

The present report deals with twenty-seven cases of primary carcinoma of the liver, thirty cases of carcinoma of the gallbladder and thirty-three cases of carcinoma of the extrahepatic bile ducts diagnosed during the period from 1927 to 1951 inclusive on the Yale University Service of the Grace-New Haven Community Hospital. Only histologically proven malignancies are included; and when there has been doubt as to the primary origin of a particular neoplasm, it has been omitted from this study. During the twenty-five-year period covered by this report 8,131 autopsies and 1,789 surgical procedures on the biliary tract were performed on the University Service.

PRIMARY CARCINOMA OF THE LIVER

In the present series the autopsy incidence of primary carcinoma of the liver was 0.33 per cent, which closely resembles other reported series. (Table 1.) Generally it is believed that carcinoma of the liver is more common in Asiatic and African than in Caucasian populations. Some of the reasons which lead to this conclusion are detailed in the discussion of etiology.

A review of the literature (Table 1) reveals that most cases of primary malignancy of the liver occur in the fifth to seventh decades of life (the so-called "cancer age") although cases have been reported as occurring in infancy[38] and in very old persons. In the present series 63 per cent of patients were between the ages of fifty and seventy years inclusive. The average age was 57.4 years. Steiner[38] has published an interesting survey including seventy-five proven cases under the age of sixteen years in which 53.2 per cent of the patients were less than two years of age.

Carcinoma of the liver is a disease which occurs primarily in males (Table 1), which may be related to the known incidence of

* From the Department of Surgery (Oncology) and the Tumor Registry, Yale University School of Medicine and the Grace-New Haven Community Hospital, New Haven, Conn. This paper was awarded first prize in a competition sponsored by the American Cancer Society and the Connecticut Association of Tumor Clinics.

cirrhosis. In the present series 70 per cent of the patients were males.

Etiology. The etiology of primary carcinoma of the liver long has been under discussion and still no specific etiology has been found. Warvi[44] in an excellent discussion of the subject states that the general consensus regarding etiology can be divided into four categories: (1) embryonal rests of liver cells or accessory duct structures; (2) long-standing chemical, bacterial, mechanical or toxic irritation affecting liver cells; (3) progressive cirrhotic changes; and (4) avitaminosis or disturbed nutrition altering the metabolism and growth of liver cells. Steiner[38] also suggests a possible congenital factor because of the many proven cases in children.

Japanese investigators[46] have emphasized the possible etiologic role of chemical irritation, for long ago they demonstrated that butter yellow (an azo dye which is common in the Japanese diet) fed to rats caused carcinoma of the liver. This may account for the high incidence of primary liver malignancy in Japan.

Animal parasitic infestation also has been suggested by many investigators to be one of the possible causes for the high incidence in Asiatic and African populations. Prates[31] reported a high incidence among the African Bantu tribes and believes that a dietary factor may be the cause. Parasitism is probably not responsible according to Prates since it is present throughout Africa without the high incidence of carcinoma found in the Bantu tribe.

The relation of cirrhosis to carcinoma of the liver has never been adequately elucidated. That there is a definite correlation has been shown by many investigators. (Table 1.) In the present series of cases, however, only 33.3 per cent of livers showed cirrhotic changes. Fried[14] suggests that "cirrhosis is a repair process due to injury followed by a compensatory hypertrophy and hyperplasia of liver cells giving rise to formation of multiple adenomatous nodules which may eventually become excessive to such a degree as to form carcinomata." Rowan and Mallory[33] were of the opinion that pigment cirrhosis (hemochromatosis) is the type most commonly complicated by liver cell carcinoma.

TABLE 1
CARCINOMA OF THE LIVER

Author	Cases	Autopsies	Autopsy Incidence (%)	Average Age	Males (%)	Cirrhosis (%)	Pathology (%)		
							Hepatoma	Cholangioma	Other
Charache[8]	808	159,762	0.506	.....	.....	.....	....	..	...
Counsellor and McIndoe[10]	5	5,976	0.08	.....	100	100	....	..	...
Fried[14]	169	.....	.....	.....	.....	80	82	18	...
Hoyne and Kernohan[18]	31	16,303	0.19	Male 58.5 Female 48.9	74.2	55	64	36	...
Lemmer[23]	18	5,228	0.28	61	61	55.5	61	33	6
McNamara et al.[28]	34	5,400	0.629	.....	.....	73.5	73.5	20	6.5
Webb[45]	12	1,817	0.66	.....	83	100	91	9	...
Wilbur et al.[46]	49	11,045	0.444	40 Over 40	96	54	92	8	...

Clinical Features. Clinical signs and symptoms usually are definite in patients with carcinoma of the liver; abnormalities are present but these usually lack the clear-cut signs of malignancy. The most common presenting symptoms in the present series were weight loss, abdominal pain and jaundice. Weight loss was present in 44 per cent of patients, pain was present in 41 per cent and jaundice was observed in 33 per cent. Physical examination revealed a palpable liver in 70 per cent with a separate abdominal mass present in 37 per cent and right upper quadrant abdominal tenderness in 25 per cent. Gastrointestinal symptoms such as dyspepsia, nausea and vomiting were present in 29 per cent of cases.

It is readily apparent that there is no striking clinical syndrome of specificity. The diagnosis

is vague at the outset and usually is stated by the clinician during the period of study as one possible diagnosis to be ruled out at operation when suspected. In thirteen cases of the present series the diagnosis was mentioned as a likely possibility but in the remaining fourteen cases a benign lesion was believed to be the case of the symptomatology.

The course of the disease is usually brief in that patients die a relatively short time after symptoms appear. It is not remarkable then that 60 per cent of the present series had a tissue diagnosis made at postmortem examination. Exploratory laparotomy was performed in 48 per cent of cases with positive biopsies for carcinoma being taken in 40 per cent of the total series. (In one case the liver was grossly normal; in another case there was no biopsy. Both of these were proven at autopsy examination to be carcinoma.) In six patients the primary carcinoma of the liver was found incidentally at autopsy, a not uncommon time for the diagnosis to be made when the lesion is small and in an elderly patient with cirrhosis.

In general, carcinoma of the liver does not make its presence known in early stages. By the time clinical signs and symptoms appear, the disease is far advanced. When the disease becomes evident clinically, however, the resulting illness is usually not vague and indefinite but rather striking in its incapacitating qualities. As a consequence the delay is short between the appearance of first symptoms and the first visit to the physician. In the present series 59 per cent of patients had symptoms of less than three months' duration before seeking medical attention. Symptoms were present in 85 per cent of patients less than a year.

Laboratory Studies and Roentgenographic Findings. Laboratory studies were not particularly helpful in arriving at a diagnosis. Anemia was present to some degree in 37 per cent of the patients in the present series and leukocytosis was noted in 29 per cent. Liver function studies were performed in only one patient with cirrhosis and were reported as abnormal.

Contrast roentgenograms of the upper gastrointestinal tract were made in fifteen patients and interpreted as abnormal in twelve cases. In the latter cases the findings in five suggested malignancy (extrinsic pressure defects of stomach or duodenum).

Cholecystograms were done on nine patients and barium enemas on four. Of the former, six demonstrated no abnormality as did three of the latter. There was no suggestion of malignancy in any of the latter two groups of films.

Pathologic Classification. (Table 1.) Primary malignancy of the liver can be divided into three groups: (1) Malignant hepatoma or liver cord cell tumor (75 per cent of liver tumors); (2) bile duct cell carcinoma or cholangioma (20 per cent of liver tumors); (3) miscellaneous types such as spindle cell sarcoma, hemangioblastoma and others (5 per cent of liver tumors). In the present series 67 per cent were hepatomas and 18 per cent cholangiomas. Tumors of other histologic types included one endothelioma, one hemangioblastoma and two spindle cell sarcomas.

At one time it was suggested that distant metastases were rare in primary liver carcinoma but this has not been verified by more recent reports. Steiner[38] found distant metastases in 38 per cent of cases, McNamara et al.[28] in 32 per cent, Webb[45] in 25 per cent, and Hoyne and Kernohan[18] in 67.7 per cent. In the present series there were distant metastases in 22 per cent of patients. Auerbach and Trubowitz[2] report an interesting case with extensive skeletal metastases and panhematocytopenia.

Treatment. Treatment of primary carcinoma of the liver has been almost non-existent. A few cases have been reported in which partial hepatectomy has been successful. Freeman and Moreland[13] reported on a patient who lived twenty-three months after left lobectomy and at autopsy only residual intrahepatic tumor was found. Woods and McClure[47] described one patient living and well twenty-five months after resection of the left lobe of the liver. In no case in the present series was surgical excision of the tumor attempted.

It has been noted by many observers that survival without treatment is very brief once a diagnosis has been established. In Lemmer's series[23] the longest survival was forty-six months while the average time elapsed from the onset of symptoms to death was seven months. In the group of cases described here 49 per cent of patients were dead in less than six months after onset of symptoms and 70 per cent lived less than twelve months. One patient survived eight years without operation.

CARCINOMA OF THE GALLBLADDER

Carcinoma of the gallbladder is almost as hopeless a problem as primary liver carcinoma. However, surgical treatment exists if cases can be discovered early enough in their course.

Arminski[1] in an excellent collective review analyzed twenty-three reports of 206,098 autopsies and found 908 primary carcinomas of the gallbladder, an incidence of 0.43 per cent. The operative incidence in 46,480 operations on the biliary tract collected from the literature by the same author revealed 569 cases or 1.12 per cent incidence. Other investigators have had similar experience. (Table II.) In the present series there were thirty cases of carcinoma of the gallbladder in 8,131 autopsies and 1,789 surgical procedures on the biliary tract, an incidence of 0.36 per cent and 1.7 per cent, respectively.

The age occurrence of carcinoma of the gallbladder corresponds to the general carcinoma age group. (Table III.) In the present series 97 per cent of patients were over fifty years of age and 70 per cent were between the ages of sixty and eighty years inclusive.

Carcinoma of the gallbladder is primarily a disease of women. This may be related to the higher incidence of cholelithiasis among females but this has never been definitely established In the present series 80 per cent of the patients were females.

Etiology. As in other types of cancer, no definite etiology has been proven. It is believed by many investigators that cholelithiasis is probably a predisposing factor which through chronic mechanical irritation (a known carcinogenic factor) eventually leads to malignant changes. There has been much experimental work done in this regard. Burrows[6] reviewed the literature up to 1933 and concluded that laboratory experiments to that time had failed to establish a causal relationship between presence of calculi in the gallbladder and carcinoma. In 1947, however, Petrov and Kortkina[30] reported that sterile, hard foreign bodies may produce carcinoma in the gallbladder of the guinea pig. The relationship of this fact to human cholelithiasis is still undetermined. The incidence of cholelithiasis in cases of carcinoma of the gallbladder is certainly higher than in the general population and may be an important factor worthy of consideration. (Table III.) This is so convincing that many surgeons recommend the removal of any gallbladder with calculi, symptomatic or asymptomatic, lest cancer develop. They point out that the operative mortality for cholecystectomy of between 1 and 2 per cent in most clinics is less than the 4 or 5 per cent of patients with gallstones in whom cancer of the gallbladder will eventually develop.[3,12,15,16,32,35,40] Opposition to this view of prophylaxis exists in arguments that many unnecessary operations would be performed on this basis.[34,43]

TABLE II
INCIDENCE OF CARCINOMA OF THE GALLBLADDER

Author	Cases	Cases of Cancer of Gallbladder	Incidence (%)
Autopsy			
Arminski[1]	1,492	25	0.53
Benjamin[3]	25,283	84	0.33
Campbell[7]	5,623	45	0.39
Cooper[9]	2,941	18	0.61
Gariepy and Gardner[15]	900	19	0.11
Jones[19]	8,808	30	0.34
Kirschbaum and Kozoll[21]	13,330	55	0.41
Surgical (Biliary Tract Operations)			
Arminski[1]	2,500	25	0.84
Campbell[7]	1,353	45	2.50
Cooper[9]	1,500	45	3.0
Finney and Johnson[12]	1,192	18	1.5
Gariepy and Gardner[15]	1,777	19	1.01
Jones[19]	3,000	35	1.16
Marshall and Morgan[25]	1,336	19	1.4
Neibling et al.[29]	14,000	107	0.76
Russell and Brown[34]	1,488	29	1.9
Ulin et al.[41]	500	14	2.8
Vadheim et al.[42]	33,500	291	0.87

In the current series 43 per cent of patients had cholelithiasis and 37 per cent had chronic cholecystitis. During the past twenty-five years 1,789 biliary tract operations have been performed in this hospital, and 1.537 of these patients had cholelithiasis. The incidence, therefore, of carcinoma among the calculous gallbladders removed surgically in this hospital was 1.9 per cent.

Clinical Features. Carcinoma of the gallbladder, like primary liver carcinoma, gives its first clinical signs and symptoms late in the course of the disease. In Ulin's series,[41] how-

ever, symptoms were present an average of two years before treatment while in Jones' series[19] symptoms were present less than six months in 66 per cent of patients.

Many classifications of the clinical features presented by patients with this disease have been devised. One of the most convenient is a four-fold division as follows (with the incidence of each type in the present series): (1) symptoms of gallbladder disease (dyspepsia, fatty food intolerance) without cancer signs and symptoms such as weight loss and anemia (10 per cent); (2) symptoms of gallbladder disease with cancer symptoms (33 per cent); (3) rapid onset and development of new symptoms referable to the right upper abdominal quadrant (56 per cent); (4) incidental finding of cancer after cholecystectomy for other than carcinoma (1 per cent).

Symptoms were present less than three months in 67 per cent of the present group before medical attention was sought. Thirteen per cent of the patients had symptoms more than two years. Pain (including colic) was present in 60 per cent, dyspepsia in 56 per cent, jaundice in 56 per cent and weight loss in 43 per cent. Jaundice, one of the most common clinical features, appears only when the disease is far advanced, as when the common bile duct is involved. The liver was palpable in 53 per cent and a right upper quadrant mass separate from the liver was palpable in 50 per cent in the present group. Right upper quadrant tenderness was present in only 26 per cent.

Because of the indefinite signs and symptoms and paucity of laboratory aids, exploratory laparotomy remains the only way of diagnosing carcinoma of the gallbladder in the majority of cases. In the present series, however, the diagnosis of malignancy was suggested in 83 per cent of patients preoperatively. At operation twenty-three patients displayed gross carcinoma. No operation was performed in six cases for a variety of reasons including poor operative risk and death shortly after admission. In one case it was believed at operation that a pathologic condition other than malignancy was responsible for the clinical picture. Biopsy at operation showed carcinoma in twenty-four cases, and in the remaining six cases in the present series no tissue diagnosis was made until autopsy was performed.

TABLE III
CARCINOMA OF THE GALLBLADDER

Author	Cases	Average Age	Percentage of Females	Cholelithiasis (%)
Arminski[1]	25	58.7	95	80
Benjamin[3]	84	62.0	56	57
Campbell[7]	45	57.7	75	83
Cooper[9]	48	53.6	77	79
Finney and Johnson[12]	18	67.4	88	61
Gariepy and Gardner[15]	19	57% in 7th decade	74	84
Gray and Sharpe[17]	291	59.2	72	50
Jones[19]	50	100% over 40	72	82
Kirschbaum and Kozoll[21]	55	68% between 50 and 70	62	72.6
Neibling et al.[29]	107	61.4 female 56.4 male	..	....
Russell and Brown[34]	29	68% between 50 and 70	79	....
Sainburg and Garlock[35]	75	.....	84	55
Ulin et al.[41]	14	61	92	75

Laboratory Studies and Roentgenographic Findings. Laboratory studies aided little in making a diagnosis. Anemia was present in 36 per cent and leukocytosis in 50 per cent of patients.

Roentgenograms likewise have been of little value. Kirklin[20] reported a series of sixty-one primary carcinomas of the gallbladder found at operation in which sixteen patients had cholecystograms preoperatively. In fourteen cases no gallbladder shadow appeared; in one case there was normal function, and in the

remaining case a shadow of normal density was present. Taterka[39] described one case of carcinoma in which the tumor produced a relatively large, irregular defect along the outer wall of the gallbladder. There was also a slight concavity of the wall opposite the growth which he attributed to spasm. This latter finding is similar to the picture presented by gastric malignancy.

In the present series upper gastrointestinal contrast films were made in eighteen patients, and in thirteen cases they were interpreted as abnormal. In eleven of these patients the findings were suggestive of malignancy (constriction of the second part of the duodenum or extrinsic pressure defect of the duodenum). Cholecystograms were made in eight patients and all were reported as abnormal but malignancy was not mentioned as a specific possibility. Barium enemas were done in two patients; one case was negative and the other was suggestive of malignancy (a patient with far advanced carcinoma of the gallbladder with colon involvement).

Pathologic Classification. The largest percentage of cancers of the gallbladder are adenocarcinoma. Arminski[1] reviewed 502 cases from the literature and 91.2 per cent were adenocarcinoma; in the present series 93 per cent were of this histologic type.

Treatment. As was pointed out earlier, prophylaxis (removal of all calculus-containing gallbladders) is probably the most logical approach if the toll of gallbladder cancer is to be reduced. When the lesion is actually present, however, and is not too far advanced, cholecystectomy is still the procedure of choice so that the prophylactic becomes the therapeutic measure in the presence of an early diagnosis. More radical extirpation of tissue also has proven to be of value in more advanced cases. The over-all results, however, are poor since few cases are seen early. Marshall and Morgan[25] reported 20 per cent of patients and Vadheim et al.[42] 26.5 per cent of patients with resectable lesions. Booher and Pack[4] reported a patient with a five-year cure after undergoing cholecystectomy and dissection of the cystic nodes for anaplastic carcinoma. Sainburg and Garlock[35] report one patient alive thirteen and a half years after cholecystectomy, while the remaining patients operated upon were all dead in less than three years following operation. Campbell[7] reported on three patients who survived more than nine years following cholecystectomy for early lesions. Gariepy and Gardner[15] reported that 26 per cent of patients were alive and apparently well from eighteen months to seven years after cholecystectomy.

Cases in which more radical surgery has been performed were reviewed by Sheinfeld.[36] Only 19.4 per cent of thirty-six cases had good palliative or possible good long term results. He believes that where technically possible, liver reaction appeared to be of definite palliative value. Thorek[40] agrees that partial hepatectomy is indicated when the lesion is small and solitary.

In the present series 50 per cent of patients were declared non-resectable at operation while 27 per cent (eight patients) were treated for palliation. Of those patients who underwent palliative procedures, two patients survived nine months after operation and the remaining patients all died in less than six months. Cholecystectomy was performed in one case as specific therapy and the patient lived five months after operation. Twenty per cent of the patients did not undergo surgery. Sixty-seven per cent of the patients in the present series survived less than six months after symptoms were first noted.

EXTRAHEPATIC BILE DUCTS

Carcinoma of the extrahepatic bile ducts closely resembles malignancy of the gallbladder. The chief difference is the relatively early appearance of symptoms in most cases. Despite the early symptomatology, however, surgical extirpation of the lesion with resultant cure is rare because of the anatomy in this region. Even early cancer so rapidly involves nearby structures that it becomes mechanically difficult to remove the tumor. In recent years the technic of radical pancreatoduodenectomy has advanced to the stage where it is commonly attempted in the hope of effecting a cure. Few long term "cures," however, have been recorded.

Determination of the precise site of origin of malignancy in this area is more difficult than elsewhere in the biliary tract. Even a small carcinoma invades the area so completely that it is impossible to determine whether the tumor has arisen from the bile ducts, the ampulla of Vater or the head of the pancreas. In the present study only those cancers unequivocally proven to be of bile duct origin (excluding the ampulla of Vater) are included.

Varying statistics have been reported by investigators in the past. (Table IV.) In the present series thirty-three cases were demonstrated in 8,131 autopsies and 1,789 biliary tract operations, an incidence of 0.4 per cent and 1.8 per cent, respectively.

rapid onset of fulminating signs and symptoms. In the present series 73 per cent of patients had rapid onset of new symptoms less than three months before being seen medically for the first time, and only 27 per cent of patients had symptoms of chronic disease of the gallbladder

TABLE IV
CARCINOMA OF THE EXTRAHEPATIC BILE DUCTS

Author	Cases	Autopsies	Autopsy Incidence (%)	Biliary Operations	Surgical Incidence (%)	Average Age	Males (%)	Cholelithiasis (%)
Gray and Sharpe[17]	119	.....	.....	.....	...	59.2	61	31
Kirschbaum and Kozoll[21]	62	13,330	0.46	.....	...	58% from 50 to 70	71	30.6
McLaughlin[27]	7	9,523	0.073	.....	...	....	..	....
Neibling et al.[29]	66	12,000	0.26	14,000	0.5	....	..	57
Siler and Zinninger[37]	10	....	.....	.....	...	61.5	..	....

The largest number of patients were in the fifty to seventy year old age group in most series reported (Table IV.) In the present group 67 per cent of the patients were in this age group.

Unlike carcinoma of the gallbladder, malignancy of the extrahepatic ducts afflicts more males than females. Martin and Page[26] state that a 50:35 male to female ratio is commonly quoted. Neibling et al.[29] had 53 per cent males in their series. In the present group 64 per cent were males.

Etiology. Cholelithiasis has been suggested as a possible etiologic factor by virtue of chronic mechanical irritation in the same way it has been implicated in carcinoma of the gallbladder. However, the incidence of calculi in patients with carcinoma of the extrahepatic bile passages is much less than in malignancies of the gallbladder but more than in the general population. Neibling et al.[29] found 57 per cent of patients with cholelithiasis while Gray and Sharpe[17] found only 31 per cent with stones. In the present group 30 per cent of patients were proved to have cholelithiasis. The similarity of normal bile to known carcinogenic compounds has suggested another possible etiology according to some investigators,[11,29] but this relationship has not been proved.

Clinical Features. Chronic disease of the gallbladder is uncommon in patients who developed cancer of the extrahepatic bile ducts. The most common clinical picture is one of with or without additional signs and symptoms of cancer.

Jaundice was evident in 73 per cent of the present group, dyspeptic symptoms in 48 per cent, abdominal pain in 39 per cent and weight loss in 39 per cent. Abnormal physical findings also included palpable liver in 51 per cent of patients, right upper quadrant mass in 51 per cent and right upper quadrant tenderness in 25 per cent. Because symptoms are seldom vague, there is usually only a brief delay before patients are seen by a physician. In the present series 75 per cent of patients had symptoms less than three months before their first medical visit.

Exploratory laparotomy remains the only way a definite diagnosis can be made in a living patient. In Neibling's series[29] 61 per cent of the preoperative diagnoses were malignancy, but only 8 per cent located the cancer specifically in the biliary tract. In the present series diagnoses of malignancy were made preoperatively in 85 per cent of patients, about half of which located the primary lesion in the biliary tract. The final diagnosis was made by operative biopsy in 94 per cent of cases and by autopsy examination in the remainder. These latter patients were the only ones who did not come to operation.

Laboratory Studies and Roentgenographic Findings. Routine laboratory data has proved valueless. There are no consistent changes in the hematologic status in these patients. In the

present series 50 per cent of the patients had anemia and 33 per cent had leukocytosis.

Roentgenography has been somewhat more valuable here than in other biliary tract malignancies at the Grace-New Haven Community Hospital, with seventeen of twenty-seven upper gastrointestinal contrast roentgenograms reported as suggestive of malignancy (constriction of the second part of the duodenum or extrinsic mass deforming the duodenum). Abnormal films suggestive of malignancy (abnormal contour of bile passages) were also present in twelve of fourteen cholecystograms. All of these films interpreted as showing malignancy were in patients with far advanced carcinoma.

Treatment. Radical operation appears to be the only way of approaching carcinoma of the extrahepatic bile ducts if cure is the goal. In 1935 Whipple reawakened interest in pancreatoduodenectomy; at first a two-stage procedure but later a one-stage operation was devised. Reports, however, have been discouraging in terms of long time survivals. Leiter[22] reported four cases of survival after radical extirpation of carcinoma in this area, one patient for nineteen months and three patients for nine months each. Brunschwig[5] reported on twenty-three patients who underwent pancreatoduodenectomy for carcinoma of the pancreas and ampullary region, of whom seventeen survived. Good palliation resulted in six patients, three of whom lived an average of four and one-third years postoperatively. Nine patients lived from two to nine months after operation and died of their cancer.

At operation in the present series 50 per cent of patients were non-resectable. Palliative procedures were performed in 18 per cent and curative surgery attempted in 27 per cent, while no surgery was possible in the remaining 5 per cent of patients. Only one patient survived over six months from the palliative group and he lived six years after operation. Six patients upon whom a curative operation was attempted died in less than six months. Of those who survived longer, one lived thirteen months, one lived twenty-five months and another three years. Eighty-two per cent of patients lived less than six months from the onset of symptomatology. Microscopic pathology in all cases in the present series was adenocarcinoma.

CONCLUSIONS

1. Carcinoma of the biliary tract presents symptoms relatively late in the development of the tumor, so that longevity after symptoms appear is universally brief.

2. No satisfactory method has yet been devised to screen asymptomatic patients for cancer of the biliary tract and there is still no method of diagnosis in the patient with the early lesion.

3. Radical surgery, even in patients whose lesions appear to be early and easily resectable, has not yet produced many long term cures.

REFERENCES

1. Arminski, T. C. Primary carcinoma of the gallbladder. *Cancer*, 2: 379, 1949.
2. Auerbach, O. and Trubowitz, S. Primary carcinoma of the liver with extensive skeletal metastases and panmyelophthisis. *Cancer*, 3: 837, 1950.
3. Benjamin, E. G. Carcinoma of the gall bladder—an analysis of 70 cases. *Minnesota Med.*, 31: 537, 1948.
4. Booher, R. J. and Pack, G. T. Cancer of the gallbladder. Report of a five-year cure of anaplastic carcinoma with metastases. *Am. J. Surg.*, 78: 175, 1949.
5. Brunschwig, A. Results of pancreatoduodenectomy, *Cancer*, 2: 763, 1949.
6. Burrows, H. An experimental inquiry into the association between gall stones and primary cancer of the gall bladder. *Brit. J. Surg.*, 20: 607, 1933.
7. Campbell, D. A. A clinical study of carcinoma of the gall bladder. *Ann. Surg.*, 113: 1068, 1941.
8. Charache, H. Primary carcinoma of the liver—report of a case and review of the literature. *Am. J. Surg.*, 43: 96, 1939.
9. Cooper, W. A. Carcinoma of the gall bladder. *Arch. Surg.*, 35: 431, 1937.
10. Counsellor, V. S. and McIndoe, A. J. Primary carcinoma of the liver. *Arch. Int. Med.*, 37: 363, 1926.
11. Dick, J. C. Carcinoma of the lower end of the common bile duct. *Brit. J. Surg.*, 26: 757, 1939.
12. Finney, J. M. T., Jr. and Johnson, M. L. Primary carcinoma of the gall bladder, an additional reason for early removal of the calculous gall bladder. *Ann. Surg.*, 121: 425, 1945.
13. Freeman, B. S. and Moreland, R. B. Primary carcinoma of the liver: report of a case treated by lobectomy. *Ann. Surg.*, 127: 1240, 1948.
14. Fried, B. M. Primary carcinoma of the liver. *Am. J. M. Sc.*, 168: 242, 1924.
15. Gariepy, L. J. and Gardner, L. W. Primary carcinoma of the gall bladder. *J. Internat. Coll. Surgeons*, 11: 499, 1948.
16. Graham, E. A. Prevention of carcinoma of the gall bladder. *Ann. Surg.*, 93: 317, 1931.
17. Gray, H. K. and Sharpe, W. S. Carcinoma of the gall bladder, extra hepatic bile ducts, and the

major duodenal papilla. *S. Clin. North America*, 21: 1117, 1941.

18. Hoyne, R. M. and Kernohan, J. W. Primary carcinoma of the liver: a study of 31 cases. *Collect. papers Mayo Clin. and Mayo Found.*, 38: 72, 1947.
19. Jones, C. Carcinoma of the gall bladder, a clinical and pathologic analysis of 50 cases. *Ann. Surg.*, 132: 110, 1950.
20. Kirklin, B. R. Cholecystographic diagnosis of neoplasms of the gall bladder, *Am. J. Roentgenol.*, 29: 8, 1933.
21. Kirshbaum, J. D. and Kozoll, D. D. Carcinoma of the gall bladder and extrahepatic bile ducts. *Surg., Gynec. & Obst.*, 73: 740, 1941.
22. Leiter, H. E. Carcinoma involving the common bile duct: report of 4 cases of successful resection. *Surgery*, 22: 627, 1947.
23. Lemmer, K. E. Primary carcinoma of the liver. *Arch. Surg.* 61: 599, 1950.
24. Lemon, H. M. and Byrnes, W. W. Cancer of the biliary tract and pancreas. *J. A. M. A.*, 141: 254, 1949.
25. Marshall, S. F. and Morgan, E. S. Carcinoma of the gall bladder. *S. Clin. North America*, 18: 687, 1938.
26. Martin, W. F. and Page, G. D. Carcinoma of the extrahepatic bile ducts. *South. M. J.*, 44: 109, 1951.
27. McLaughlin, C. W. Tumours of the extra-hepatic bile ducts exclusive of the ampulla of Vater. *Canad. M. A. J.*, 28: 255, 1933.
28. McNamara, W. L., Benner, W. H. and Baker, L. A. Primary carcinoma of the liver. *Am. J. Surg.*, 80: 545, 1950.
29. Neibling, H. A., Dockerty, M. B. and Waugh, J. M. Carcinoma of the extrahepatic bile ducts. *Surg., Gynec. & Obst.*, 89: 429, 1949.
30. Petrov, N. N. and Kortkina, N. A. Experimental carcinoma of the gall bladder. *Ann. Surg.*, 125: 241, 1947.
31. Prates, M. D. Primary malignant tumors of the liver in Mozambique natives. *South African M. J.*, 14: 95, 1940.
32. Roe, W. F. and Larson, E. E. Carcinoma of the gall bladder, extrahepatic bile ducts and pancreas. *California Med.*, 69: 231, 1948.
33. Rowan, H. S. and Mallory, F. B. A multinucleated liver cell carcinoma. *Am. J. Path.*, 1: 677, 1925.
34. Russell, P. W. and Brown, C. H. Primary carcinoma of the gall bladder—report of 29 cases. *Ann. Surg.*, 132: 121, 1950.
35. Sainburg, F. P. and Garlock, J. H. Carcinoma of the gall bladder; a report of 75 cases. *Surgery*, 23: 201, 1948.
36. Sheinfeld, W. Cholecystectomy and partial hepatectomy for carcinoma of the gall bladder with local liver extension. *Surgery*, 22: 48, 1947.
37. Siler, V. E. and Zinninger, M. M. Surgical treatment of carcinoma of the ampulla of Vater and the extrahepatic bile ducts. *Arch. Surg.*, 56: 199, 1948.
38. Steiner, M. M. Primary carcinoma of the liver in childhood. *Am. J. Dis. Child.*, 55: 807, 1938.
39. Taterka, H. Cholezystographische Untersuchungen mittels "Decholindehnung" und "Eigelbentleerung." *Röntgenpraxis*, 3: 721, 1931.
40. Thorek, M. Partial hepatectomy in carcinoma of the gall bladder. *J. Internat. Coll. Surgeons*, 10: 369, 1947.
41. Ulin, A. W., Lichtenstein, I. L., Garritano, A. and Fischer, S. M. Carcinoma of the gall bladder. *Gastroenterology*, 15: 684, 1950.
42. Vadheim, J. L., Gray, H. K. and Dockerty, M. B. Carcinoma of the gallbladder. A clinical and pathologic study. *Am. J. Surg.*, 63: 173, 1944.
43. Warren, R. and Balch, F. G., Jr. Carcinoma of the gall bladder: the etiological role of gall stones. *Surgery*, 7: 657, 1940.
44. Warvi, W. N. Primary neoplasms of the liver. *Arch. Path.*, 37: 367, 1944.
45. Webb, A. C. Primary carcinoma of the liver. *Arch. Path.*, 40: 382, 1945.
46. Wilbur, D. L., Wood, D. A. and Willett, F. M. Primary carcinoma of the liver, *Ann. Int. Med.*, 20: 453, 1944.
47. Woods, C. C. and McClure, J. N. Primary carcinoma of the liver; report of a case living and well 25 months after left hepatectomy. *South. Surgeon*, 15: 538, 1949.

THE EFFECT OF BACTERICIDAL AGENTS ON THE STERILITY OF SURGICAL LINEN*

AN EXPERIMENTAL AND CLINICAL STUDY

HARRY DEAVER PROPST, M.D.
Sayre, Pennsylvania

FOR years surgeons have sought for and worked out methods to perfect surgical asepsis. To quote Meleney,[1] "Problems of surgical infection with respect to organisms which get into the patient at the time of operation cover all of the minutiae of operating room technique. This, to be effective, must be constantly checked. One source of wound contamination must not be studied or controlled and the others neglected. Wound contamination from all sources must be reduced to a minimum. This is a perennial problem and, year in and year out, the most important problem in surgical bacteriology. We have not yet reached the irreducible minimum of wound infection." Whipple[2] said, "as we may approach a limit in geometry but never reach it, so in surgery; we can minimize, but never permanently eliminate bacteria in the field. Beware of the operator who says he never has a clean wound infection."

Previous research has been focused primarily on the operative site, surgeons' hands, masks, instruments, autoclaves, air-borne contamination and suture material. Little attention has been given to the sterility of surgical linen during the operation, except to avoid contamination by direct contact with unsterile objects. Beck and Collette[3] have pointed out how easily wet drapes and gowns become contaminated. They proved that bacteria readily passed through two layers of wet cloth whereas two layers of dry cloth prevented such migration. Owens[4] and Colebrook and Hood[5] have proven that bacteria can migrate from without in through moist dressings or dressings saturated with wound exudate.

Surgical linen may become wet in several ways: (1) from perspiration of the patient or surgeon; (2) from irrigating solutions; (3) from sterile water used in cleansing instruments. Once cloth becomes damp, even if the water source is sterile, it allows contamination to take place provided it is in contact with an unsterile object, as will be demonstrated. Linen which has become dampened by perspiration is, of course, already contaminated.

Several methods of preventing this contamination are available. Gerspacher, Fowler and Rolf[6] substituted plastic drapes† for linen to eliminate contamination from this source. However, plastic drapes do not include the surgeon's garments and are expensive and allow little ventilation. Poppe[7] used zephiran®‡ 1:1000 in the wash basins to eliminate this as a source of contamination. Sterilization of the wash basin water, however, does not prevent contamination by perspiration from the surgeon or the patient. Beck and Collette[3] suggested using porous water-proof cloth or a bacteria-proof cloth.

PROBLEM

Realizing that such water and/or bacteria-proof cloth is not yet available, one is confronted with the necessity for studying the whole problem to determine (1) if bacterial migration through wet or dry linen is serious enough to warrant protective measures; and (2) what easily available materials and technics can be used to offer maximal security.

EXPERIMENTAL DEMONSTRATION

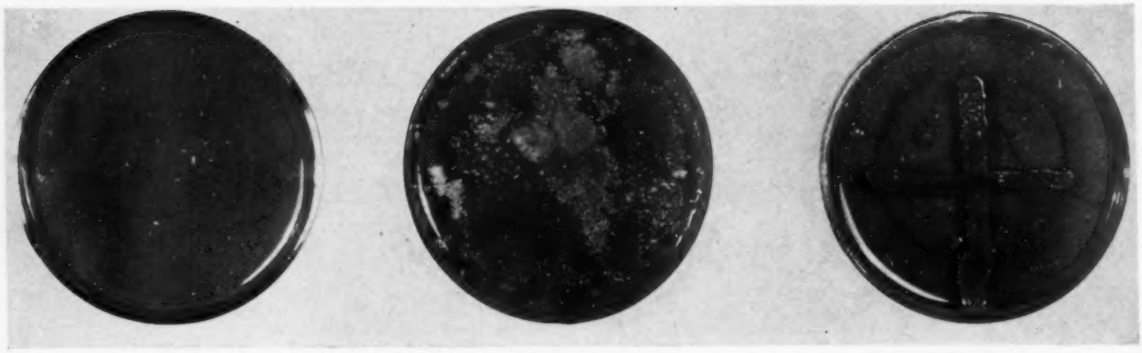
An agar§ plate was inoculated with Micrococcus pyogenes (variety aureus) in the shape of a cross and incubated for forty-eight hours. Two pieces of sterile damp surgical linen were

† Product of Minnesota Mining and Manufacturing Company.

‡ Manufactured by Winthrop-Stearns, Inc., New York, N. Y.

§ The media used was Blood Agar Base (Difco) and Tryptose Phosphate (Difco).

* From the Surgical Service of the Guthrie Clinic and the Robert Packer Hospital, Sayre, Pa.



1A 1B 1C

FIG. 1. Wet and dry cloth culture experiment. A, culture after contact for fifteen minutes on two layers of dry cloth (incubation forty-eight hours); B, culture after contact for fifteen minutes on two layers of wet cloth (incubation forty-eight hours); C, culture (Micrococcus pyogenes variety aureus).

then placed upon another sterile agar plate and the cultured cross allowed to remain in contact with the damp cloth for fifteen minutes. This was repeated using two pieces of dry sterile cloth. The cloths were then removed and the plates incubated for forty-eight hours.

TABLE 1
BACTERIOLOGY OF OPERATING ROOM UTENSILS
(MAYO STAND, INSTRUMENT TABLE AND BASIN HOLDER)

	No. of Cultures	Positive	Average No. of Colonies
No surgery in room for 48 hr.	6	0	0
No surgery in room for 24 hr.	3	2	1.6
After one case	6	2	6.8
After two cases	6	4	3.5

The agar plate inoculated through the two layers of damp cloth had a luxuriant growth. The agar plate inoculated through the dry cloth had no growth. (Fig. 1.) This experiment definitely shows how dry cloth in two layers is a barrier to transmission of bacteria, while, on the other hand, two layers of damp cloth are not. Using five, ten, fifteen, thirty and forty-five minutes' contact between the agar plate and the sterile cloths, the experiment was repeated. The times of exposure seemed to have little effect on the amount of growth, showing that the length of time for passage of bacteria is very short. This also is in accord with the findings of Beck and Collette.[3]

The objects coming in contact with sterile linen are the surgeon, the patient, Mayo stands, the instrument table and the basin holder. That the bodies of the patient and surgeon contain bacteria is accepted. However, cultures were taken from the uncovered instrument tables, Mayo stands and basin holders at varying times to prove that their surfaces harbor bacteria which, when covered with wet linen, can readily pass through to the surface. A dry sterile cotton swab was placed in sterile tryptose phosphate and on removal pressed against the side of the tube to express out as much liquid as possible. It was then streaked over the object to be cultured for a distance of approximately 1 foot and then streaked on a blood agar plate and incubated for twenty-four hours. Table 1 tabulates the results.

The operating rooms in which these cultures were obtained are all air-conditioned, situated on the seventh floor, have a mean room temperature of 72°F. and humidity of 40 to 60 per cent. All cultures in this report were taken during the fall and winter months when upper respiratory infections are prevalent but when perspiration is at a minimum.

It is interesting to note that after being empty for forty-eight hours the operating room utensils were sterile. However, there was a definite increase in the colony count recovered from the surface of these utensils after the room had not been in use for twenty-four hours preceding culture, and particularly after recent use. These cultures proved that the objects with which linen comes in contact are probably unsterile. There is reason enough, from these findings, to wash all utensils with a germicidal

solution after every case, not only after infected cases.

CLINICAL DEMONSTRATION

To prove that actual contamination takes place through linen dampened at operation, cultures were taken from both wet and dry areas of cloth covering the wound, Mayo stand, instrument tables and surgeon. During this experiment the operating room personnel became very conscious of this avenue of contamination. In several instances at the end of the operation sterile water was used purposely to dampen areas for culture purposes. The cases subjected to culture were all considered clean cases. In this instance a clean

TABLE II

CONTROL STUDY

(COMPARISON OF CULTURES OF WET AND DRY SURGICAL LINEN)

	No. Cultured	Average Colony Count	No. with Growth	Per cent	No. without Growth	Per cent
Surgical gowns						
Wet	10	2.4	8	80	2	20
Dry	27	.9	13	48	14	52
Mayo stand						
Wet	16	1.7	12	75	4	25
Dry	15	.7	6	40	9	60
Instrument table						
Wet	5	5.4	5	100	0	0
Dry	9	.4	3	33	6	66
Wound drapes						
Wet	19	5.7	16	84	3	16
Dry	14	.7	4	29	10	71
Total average						
Wet	50	3.4	41	82	9	18
Dry	65	.7	26	40	39	60

TABLE III

COMPARISON OF CULTURES OF WET AND DRY SURGICAL LINEN

(AFTER ADDITION OF ROCCAL 1:2500 TO FINAL LAUNDRY RINSE)

	No. of Cultures	Average Colony Count	No. with Growth	Per cent with Growth	No. without Growth	Per cent without Growth
Surgical gowns						
Wet	12	.33	2	17	10	83
Dry	12	.25	3	25	9	75
Mayo stand						
Wet	12	.16	2	17	10	83
Dry	12	.08	1	8	11	92
Instrument table						
Wet	11	.09	1	9	10	91
Dry	12	1.1	3	25	9	75
Wound drapes						
Wet	12	.16	2	17	10	83
Dry	11	0	0	0	11	100
Total average						
Wet	47	.19	7	15	40	85
Dry	47	.36	7	15	40	85

case was considered one not contaminated prior to or during surgery either from within the wound or from without. These cases included laminectomies, craniotomies, thyroidectomies, mastectomies and abdominal and thoracic cases prior to opening any viscus.

The operative skin areas were prepared in one of three ways: (1) an ether scrub, followed by two coats of tincture of iodine removed with 70 per cent alcohol; (2) a twenty-four hour preoperative scrub with formula 99 (Armour) containing 5 per cent hexachlorophene, the area then being covered with sterile drapes followed by another hexachlorophene scrub immediately prior to actual surgery; (3) a scrub with formula 99, which was removed by a towel and followed by the application of two coats of 2½ per cent aqueous iodine. The surgeons' hands were scrubbed with a brush and formula 99 soap from five to ten minutes followed by a brushless scrub for two to four minutes depending on the service. Cultures were taken in the same method as described previously. The findings are shown in Table II.

The average colony count per culture from the four dry areas ran between .4 and .9 or a mean average of .7. The percentage of cultures showing growth ranged between 29 to 48 per cent or 40 per cent average from the four areas. Sixty per cent of the cultures taken from dry areas of cloth were sterile.

The average colony count per culture taken from the four wet areas was between 1.7 and 5.7, or a mean average of 3.4 colonies. This is 4.7 times greater than the average colony count secured for cultures taken on dry areas. Positive cultures ran between 75 to 100 per cent with an average of 82 per cent of all cultures showing growth. This is a 104 per cent increase over the dry areas. Eighteen per cent of the cultures from wet areas showed no growth. The foregoing figures prove that a wet cloth at operation covering an unsterile area is probably contaminated and should be treated as such.

In all four areas cultured the wet areas all showed higher average colony counts. The wet instrument table and wound drapes had the highest average colony counts, 5.4 and 5.7, respectively.

The types of bacteria were not determined but the vast majority were micrococci, both albus and aureus varieties. Positive cultures were also found taken from dry areas. *In vitro* studies having proven that bacteria do not pass through dry linen, it must be assumed that these organisms probably were results of airborne contamination. The moisture of the culture swab was not a factor in the positive culture for dry areas as the second layer of cloth was never observed to have become damp.

The following conclusion was reached. Bacteria can and do migrate through wet cloth both *in vitro* and the operating room, thereby exposing the surgeon's gloved hands, instruments and suture material to contamination. The elimination or decrease in this source of contamination is in order.

MATERIALS

In considering methods of eliminating contaminative sources it was at once obvious that the simplest solution of the problem would be the coating or impregnation of existing surgical linen with a bactericidal substance, if an effective one could be found.

Any substance which could prevent bacteria from migrating through a wet cloth should be inexpensive, have a high bactericidal effect, be resistant to high temperature, able to withstand relatively low pH solutions, stable and possess no properties toxic to tissue.

Roccal®. Many germicidal agents are available to the medical profession. One of these is roccal* which is a cationic germicide, a mixture of alkyl-dimethyl-benzyl-ammonium chloride (quaternary-ammonium), technical grade, supplied in a 10 per cent solution. In the dilution used it is practically odorless, colorless, tasteless, non-toxic, highly stable and neutral. It possesses no corrosive elements. It has a wide range of antibacterial activity, being effective against Eberthella typhosa, Salmonella paratyphi, Shigella dysenteriae, Corynebacterium diphtheriae, Neisseria gonorrhoeae, Diplococcus pneumoniae, Micrococcus aureus, Streptococcus hemolyticus and Endamoeba histolytica. It shows no certain effect on tubercle bacilli or on certain spores. It is active at pH as low as 3.0 but more active in alkaline solutions. Serum may impair its action and, in general, organic matter slowly inactivates roccal. In laboratory animals it was found to be of very low toxicity,

* Manufactured by Winthrop-Stearns Inc., New York, N. Y.

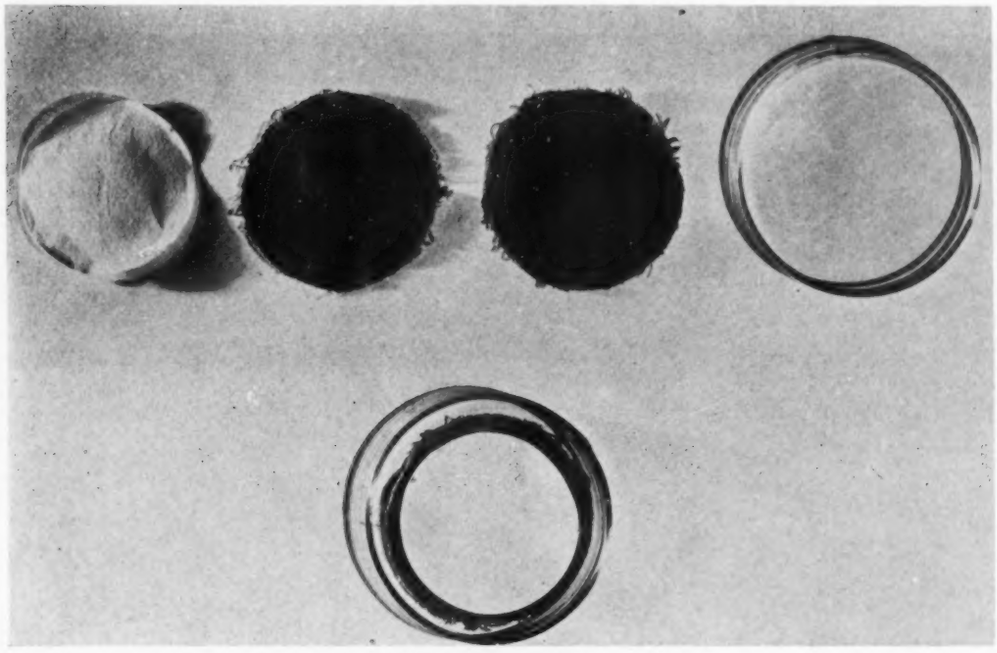


FIG. 2. Materials for roccal experiment.

with practically no skin-irritating properties. Roccal is stable to boiling and ordinary autoclaving technics.

TECHNIC

The most logical place to treat the surgical linen was in the laundry. The Robert Packer Hospital laundry normally uses the following daily procedure in laundering the surgical linen. First, the clothes are given two lukewarm rinses at 140°F., one alkaline wash at 160°F. (especially if the linen is blood-stained), two rinses with soap suds at 160°F., three hot rinses at 160°F., one lukewarm rinse at 135 to 140°F., one rinse with laundry sour at 130°F. and lastly, a neutral rinse at 110°F. Although the surgical service is disproportionately large for a 350-bed hospital, the laundry machine is large enough to accommodate all the daily operating room linen in one load. The pH of the last rinse averages between five and seven. The volume of water for the last rinse is 100 gallons. Following the washing process the linen goes into a tumbler. This tumbler reduces the water content of the laundry 70 per cent by centrifugal force and reaches a temperature of 300°F.

In making our experiment roccal (1,500 cc. of 10 per cent) was added to the last rinse to give a dilution of 1:2500. The amount used costs one dollar. An identified piece of surgical linen was then passed through the entire laundering process. Analysis of this linen was found to contain 0.44 mg. of roccal per gram of linen, or 0.07 mg. per square inch.

In vitro Studies. To prove that the identified cloth retained a sufficient amount of roccal to be effective, the following test was made. The cloth was cut into circular pads and two of these were placed on three agar plates. In each of three other agar plates were placed circular pads of linen which were not so treated. Sterile circular filter papers somewhat smaller in diameter were placed on top of these circular pads of cloth. Figure 2 illustrates the setup. The filter paper of each plate was then inoculated with a liquid culture of M. pyogenes (variety aureus). The filter paper was allowed to remain on one plate with roccal and on one without roccal for five, fifteen and forty-five minutes, respectively. The cultures were incubated for forty-eight hours. Figure 3 shows the results.

In all three plates containing the cloth without roccal there was a heavy bacterial growth. The time of contact appears to have had little effect. In the three plates where roccal had been added there was no growth. The irregular appearance of these plates (Fig. 3) is due to the pressure caused by the cloth on the agar. No colonies were detected after forty-eight hours. This was repeated many times with the same result.

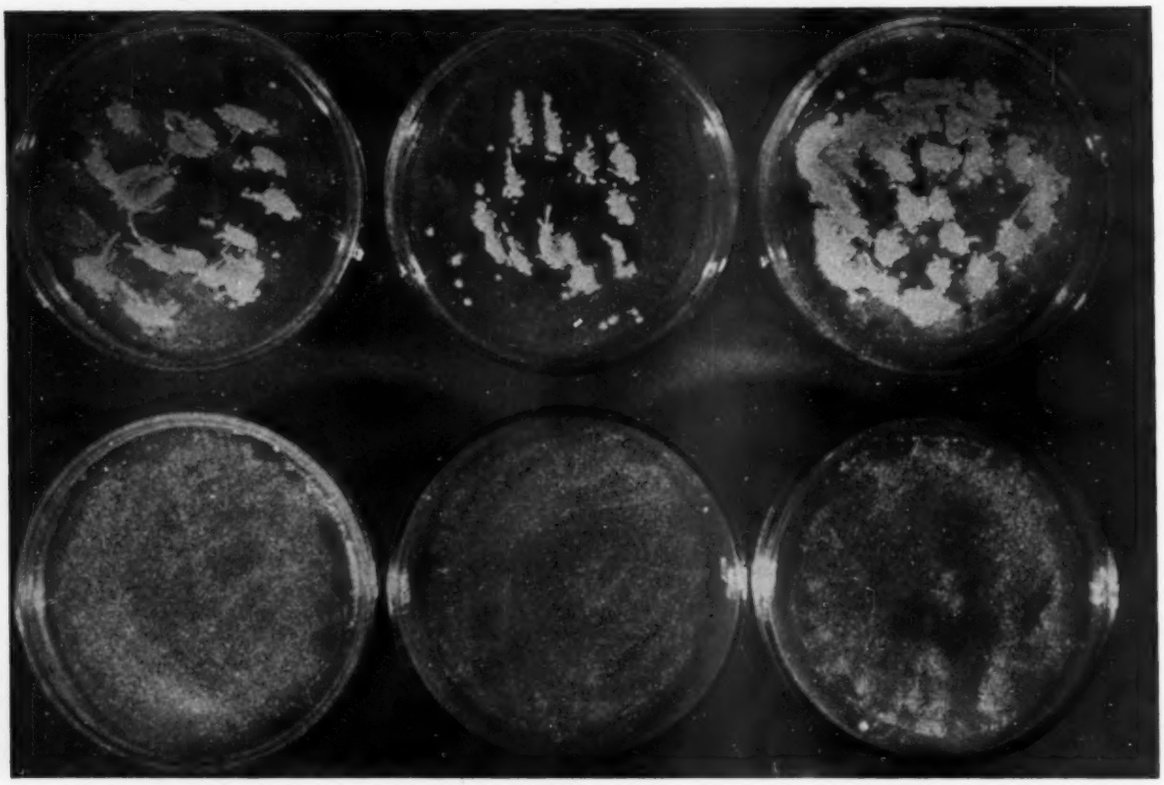


FIG. 3. Results of roccal experiment. Lower row is with roccal added to cloth; haziness in these is due to contact of cloth with agar. A, five minutes; B, fifteen minutes; C, forty-five minutes; D, five minutes; E, fifteen minutes; F, forty-five minutes.

The *in vitro* studies proved the linen treated with roccal in the hospital laundry inhibited bacterial migration even when wet.

Clinical Studies. Fifteen hundred centimeters of roccal was then added daily to the last neutral rinse. Cultures were again taken in the operating room from wet and dry areas using the same criteria as previously. The results are shown in Table III. The average colony count of the four dry areas ran between 0 and 1.1 with the mean average .36. The high average dry count (1.1) recorded from a dry instrument table was the result of one culture having eleven colonies. This particular culture was not the result of a break in our technic, since the tryptose phosphate after culture was found to be sterile and the colonies had grown in definite relationship with the streaking produced by inoculation. Only two sources remain from which this high count could have originated, either air-borne contamination or a break in surgical technic. Without this one culture the average would be .11. The average dry colony count of untreated linen was .73. The percentage of positive cultures ran between 0 to 25 with the average being 15 per cent, as compared with 40 per cent for untreated linen.

The average colony count of each of the four wet areas was between .09 and .33 with a mean average of .19 colonies. The percentage of positive cultures ranged between 9 and 17 per cent with a mean average of 15 per cent. This 15 per cent is compared with 85 per cent of positive cultures made from untreated wet linen. There was no difference in percentage of positive cultures between wet and dry cloth if treated but the average colony count of dry areas was .36 as compared to .19 for wet areas.

During the period in which roccal was being used not one case of allergy due to sensitivity was reported by the nursing staff on the surgical service.

These findings indicate that the addition of roccal to surgical linen in the dilution of 1:2500 inhibits the transmission of bacteria through the linen. This has been shown to be

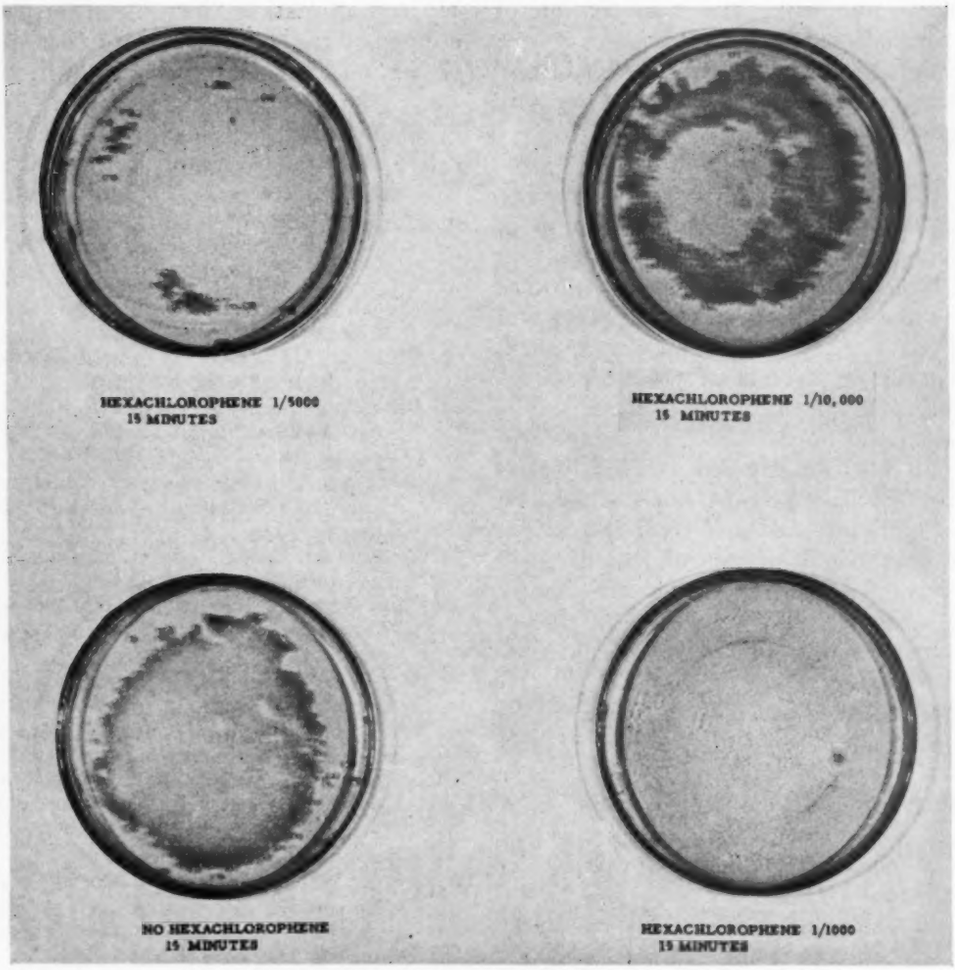


FIG. 4. Results of hexachlorophene experiment.

true *in vitro* and in the operating room. The laundry process at the Robert Packer Hospital had no untoward effects on its action. No evidence of skin sensitivity was discovered. The cost of its use was reasonable, approximately one dollar per day.

Hexachlorophene (G-11)®. Hexachlorophene is another bactericidal agent available. A number of authors[8–11] have reported very favorable results from the use of this substance in preparation of the surgeon's hands and the operative site.

Hexachlorophene (2, 2¹-dihydroxy-3,5,6,-3¹, 5¹, 6¹,-hexachloro-diphenyl-methane) has been found to have high bactericidal effects against gram-positive cocci and somewhat less active against gram-negative organisms. Traub[10] found no allergic manifestations using the patch test. It is insoluble in water and it is stable to a temperature of 300°F. and to autoclaving at a pH of 4 to 6. It can be made soluble by formation[12] of its sodium salt at 80–100 parts per million. The solubility can be further increased by addition of 5 to 15 per cent isopropanol. Its bactericidal effect is decreased in the presence of serum.

For *in vitro* studies a stock solution of 1:1000 sodium salt of hexachlorophene was made, with addition of 15 per cent isopropanol. Dilution of 1:1000, 1:5000, 1:10,000 were used to perform the same *in vitro* studies as described in the experiments using roccal. Results are demonstrated in Fig. 4.

A control agar plate showed a heavy growth as did the hexachlorophene, 1:10,000. In dilution of 1:5000 there was a decrease in the growth and at 1:1000 there was no growth. These plates also showed that hexachlorophene

* Supplied by Givaudan-Delawanna Inc., Delawanna, N. J.

is capable of inhibiting the transmission of bacteria through wet linen.

Because of its insolubility in water Gump[12] has suggested that it may be practical to apply it to surgical linen as a spray.

SUMMARY AND CONCLUSIONS

The problem of bacterial contamination of wounds via wet surgical linen has been reopened. Experimental and clinical studies which were made at the Robert Packer Hospital have proved that unprotected wet surgical linen furnishes an avenue of transmission of bacteria to wounds from unsterile areas.

Because of the potential hazard water and saline should be cautiously and judiciously used in operating rooms and wet areas should be considered contaminated and treated as such. Suggested methods of eliminating or decreasing this type of contamination are briefly discussed in this paper. One method (incorporating bactericidal agents into surgical linen) has been intensively studied.

The properties of an ideal bactericide to use in such a situation are enumerated and described.

Laboratory and clinical studies have been made to demonstrate the effectual protective qualities of roccal and hexachlorophene as such bactericidal agents.

This study has demonstrated *in vitro* and clinically that incorporating two specific bactericidal agents into the final neutral rinse in laundering surgical linen will decrease the possibilities of contamination from this source.

Since the literature indicates that this source of contamination has been neglected, it seemed advisable to suggest further studies and continued search for an ideal agent.

Acknowledgment: Acknowledgment is gratefully made to William C. Beck, M.D. and Thomas Collette, B.A., for guidance and technical assistance.

REFERENCES

1. Meleney, F. L. Surgical bacteriology. *S. Clin. North America*, 22: 319, 1942.
2. Whipple, A. O. Use of silk in repair of clean wounds. *Ann. Surg.*, 98: 662, 1933.
3. Beck, W. C. and Collette, T. S. False faith in the surgeon's gown and surgical drape. *Am. J. Surg.*, 83: 125, 1952.
4. Owens, N. Use of pressure dressings in treatment of burns and other wounds. *S. Clin. North America*, 23: 1354, 1943.
5. Colebrook, L. and Hood, A. M. Infection through soaked dressing. *Lancet*, 2: 682, 1948.
6. Gerspacher, T. S., Fowler, H. D. and Rolf, D. E. New plastic surgical drapes. *Arch. Ophth.*, 45: 673, 1951.
7. Poppe, J. K. Wash basin contamination in operating rooms. *Arch. Surg.*, 44: 103, 1943.
8. Seastone, C. V. Observations on use of G-11 in surgical scrub. *Surg., Gynec. & Obst.*, 84: 355, 1947.
9. Bowers, R. F. pHisoderm with hexachlorophene (G-11); its integrity as surgical scrub. *Am. J. Surg.*, 78: 859, 1949.
10. Traub, E. F., Newhall, C. A. and Fuller, J. R. Value of new compound used in soap to reduce bacterial flora of human skin. *Surg., Gynec. & Obst.*, 79: 205, 1944.
11. Chisholm, T. C., Ducan, T. L., Hufnagel, C. A. and Walter, C. W. Disinfecting action of pHisoderm containing 3 per cent hexachlorophene on skin of hands. *Surgery*, 28: 812, 1950.
12. Gump, W. Personal communication.

LIVER NECROSIS FOLLOWING COMPLETE INTERRUPTION OF HEPATIC ARTERY AND PARTIAL LIGATION OF PORTAL VEIN*

H. L. Popper, M.D., N. C. Jefferson, M.D. and H. Necheles, M.D., Ph.D.
Chicago, Illinois

EXPERIMENTS from this laboratory[1,2] have confirmed the observation of Markowitz and colleagues[3] that excision of the entire hepatic artery is tolerated if antibiotics are given postoperatively, and we have shown that a number of dogs survived this procedure even when no antibiotics were administered.

The completeness of obstruction of arterial blood supply through the hepatic artery was verified by injecting red lead dye through the thoracic aorta, which is necessary to ascertain that no collaterals or atypical hepatic branches from other arteries have been overlooked.[1,2]

Survival of animals with or without antibiotics could be explained by the presence of collateral arterial circulation to the liver, mainly from branches of the phrenic arteries. It was apparent that sufficient collateral circulation had to be actually available at the time of excision of the hepatic artery or that the liver had to be tided over its state of anoxia by antibiotics until collateral circulation had increased sufficiently to prevent fatal necrosis of the liver. It is probable that other homeostatic compensatory mechanisms are operative in addition to essential collaterals. Observations by Eze,[4] as well as by the authors,[1,2] that a single and relatively small dose of penicillin may be sufficient to prevent liver necrosis, point in this direction. The effect of the penicillin is obviously of too short duration to ascribe survival of the liver to development of extensive collaterals alone. Other protective reactions must begin to operate while the anoxic cells of the liver are protected from bacterial action by penicillin.

Following interruption of the hepatic arterial blood flow, oxygen tension in the liver drops and greater amounts of oxygen are probably withdrawn from the portal blood. At the same time, the supply of oxygen to the liver may be augmented by an increased portal blood flow and by the opening of intrahepatic arteriovenous communications which, by reversed flow, can bring portal blood to areas of the liver to which normally only arterial blood has access. These processes may become effective within a few hours, and in the meantime the antibiotics may protect the liver against harmful bacterial growth. However, such compensatory mechanisms alone are not sufficient to prevent liver necrosis.

We were able to show[5] that interruption of the entire arterial blood supply to the liver, including the hepatic branches of the phrenic arteries, led to fatal liver necrosis which could not be prevented by antibiotics. Yet it was impressive how little collateral arterial blood supply was sufficient to prevent massive necrosis. Evidently the amount of oxygen the liver gets from the portal blood is almost but not entirely sufficient to prevent necrosis if all arterial blood supply is cut off.

In continuation of these experiments it seemed worth while to study the effect of combining excision of the hepatic artery with interruption of the portal blood flow.

This could be effected by interruption of the hepatic artery and performance of a classical Eck fistula. However, the metabolic and circulatory changes following such combined procedure are formidable, and Rappaport[6] has shown that it is fatal when performed in one stage. A two-stage procedure, on the other hand, entails the probability of development of collateral circulation and of adaptation of the liver to lower oxygen supplies, which would make the evaluation of results very difficult.

* From the Department of Gastro-Intestinal Research of Michael Reese Hospital, Medical Research Institute, Chicago, Ill. Supported by the Otto Baer Fund. The Department is in part supported by the Michael Reese Research Foundation.

We decided, therefore, to try a different approach. If following interruption of the hepatic artery portal blood is necessary for the prevention of liver necrosis, as our experiments had suggested,[5] we should expect partial liver necrosis when part of the liver is deprived of its portal blood flow. The portal vein divides at the liver hilum into several big branches which go to the different liver lobes. If some of these branches were ligated, the rest of the portal system would carry the portal blood through the liver without stagnation in the portal vein. We would thus deprive part of the liver of its portal blood without encountering the metabolic changes which follow the establishment of an Eck fistula. Since ligation of branches of the portal vein can be combined easily with excision of the hepatic artery, we would have an experimental procedure where the arterial supply to the liver is cut off with the exception of the hepatic branches of the phrenic arteries; the portal blood flow would be interrupted to part of the liver only, while the rest of the liver would retain its normal portal blood flow.

PROCEDURE

Seventeen male and female mongrel dogs of medium size were operated upon under pentobarbital anesthesia and with aseptic conditions. In twelve dogs between one and two-thirds of the branches of the portal vein were ligated at the liver hilum, the hepatic artery was excised completely[1,2] and a cholecystectomy was performed.

RESULTS

Ligation of portal branches was not followed by discoloration of the liver or by congestion of the portion of the portal vein distal to the ligature. However, following subsequent excision of the hepatic artery, some pallor of the liver was noted frequently. Postoperatively the dogs received intravenous glucose and daily injections of penicillin and streptomycin.

Two dogs in which only about one-third of the portal branches were ligated survived, and they were sacrificed on the seventh and twelfth postoperative day, respectively. The other ten dogs died within a few days. No dog in which one-half or more of the portal branches had been ligated survived for more than two days. Postmortem examination of the dogs which died and of the dogs which were sacrificed showed massive necrosis of those lobes of the liver the portal vein branches of which had been ligated.

In five dogs the same procedure was performed in two stages. In two animals the hepatic artery was excised at a first stage and the portal vein branches were ligated a few days later. At this time the liver was inspected and found to be entirely normal in one dog, and to show a few small areas of discoloration in its middle portion in the other animal. In the other three dogs branches of the portal vein were ligated at a first stage operation. Two of these animals did not receive antibiotics while the third one did. At reoperation the liver showed a hemorrhagic infarct (Zahn's infarct) in one of the dogs without antibiotics, and it appeared completely normal in the other two dogs. Following the second operation all animals died with extensive liver necrosis, corresponding to the area of the ligated portal branches, just as in the first group of dogs. Necrosis was always most pronounced in the central areas of the liver, while the areas close to where the branches of the phrenic arteries enter usually showed less pronounced changes.

COMMENTS

Our repeated observations have shown that excision of the hepatic artery from the celiac axis up to the liver hilum is tolerated well if antibiotics are given postoperatively. Rarely it produces scattered areas of necrosis, usually in the middle portion of the liver which is most remote from the area where the hepatic branches of the phrenic arteries enter the organ. Our previous experiments had shown that the hepatic branches of the phrenic arteries are essential for survival of the liver after excision of the hepatic artery, and that by simultaneous interruption of these arterial branches and of the entire hepatic artery, fatal necrosis of the liver will inevitably ensue.[5]

Following interruption of the main arterial supply, very little arterial blood seemed to be sufficient to prevent fatal necrosis because the liver always gets some oxygen from the portal blood. The portal blood plus the limited amount of arterial blood entering the liver through the hepatic branches of the phrenic arteries supply sufficient oxygen, but the portal blood alone without the blood from phrenic arterial branches seems inadequate to prevent necrosis. On the other hand, the phrenic

arteries alone without portal blood are insufficient, and any lobe which is deprived of its portal blood in addition to complete ligation of the hepatic artery will become necrotic with or without the use of antibiotics. However, in a liver with normal arterial circulation a complete shunt of the portal blood into the vena cava (classical Eck's fistula) is tolerated and does not cause necrosis of the liver.

CONCLUSIONS AND SUMMARY

In the dog the liver will survive without portal blood flow if normal arterial circulation is present. It will survive without the hepatic artery and its collaterals if, in addition to the intact hepatic branches of the phrenic arteries, a normal portal blood flow is present.

Although ligation of the entire hepatic artery can be performed without undue consequences with the help of antibiotics, simultaneous complete ligation of the hepatic artery and of branches of the portal vein causes necrosis of that portion of the liver which is deprived of its portal blood supply. This is not preventable by antibiotics. If a greater portion of portal vein branches are tied off, extensive fatal liver necrosis follows.

These conclusions from animal experiments apply probably to conditions in man. Although ligation of the hepatic artery or its branches need not be feared any more with the use of antibiotics, the simultaneous ligation of branches of the hepatic artery and of corresponding branches of the portal vein will in all probability lead to necrosis of the respective portion of the liver.

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REFERENCES

1. Jefferson, N. C., Proffitt, M. M. and Necheles, H. Collateral arterial circulation to the liver of the dog. *Surgery*, 31: 724, 1952.
2. Jefferson, N. C., Proffitt, M. M. and Necheles, H. Collateral arterial circulation to the liver. *Am. J. Physiol.*, 167: 3, 800, 1951.
3. Markowitz, J., Rappaport, A. and Scott, A. C. The function of the hepatic artery in dog. *Am. J. Digest. Dis.*, 16: 344, 1949.
4. Eze, W. C. Cause of survival of dogs without a hepatic artery. *Arch. Surg.*, 65: 684, 1952.
5. Popper, H. L., Jefferson, N. C. and Necheles, H. Interruption of all arterial blood supply to the liver not compatible with life. An experimental study. *Am. J. Surg.*, 84: 429, 1952.
6. Rappaport, A. M. Liver injury. Transactions of the Tenth Liver Conference, p. 146. New York, May 21–22, 1951.

A CLINICAL EVALUATION OF SUCCINYLCHOLINE CHLORIDE AS A MUSCLE RELAXANT IN ANESTHESIA*

P. C. LUND, M.D.
Johnstown, Pennsylvania

THE most significant development in anesthesiology during the past decade has been the introduction of various natural and synthetic agents which are capable of producing muscular relaxation by interrupting neuromuscular transmission of impulses.

TABLE 1
TOTAL SERIES

Operative Procedures	No. of Cases	Anesthetic Technics		
		Intravenous (Surital)	Balanced*	Lumbar
Bronchoscopy	31	31	...	..
Esophagoscopy	7	7	...	..
Intrathoracic	3	..	3	..
Cesarean section	6	1	4	1
Upper abdomen	8	..	2	6
Lower abdomen	64	3	54	7
Gynecologic-major	38	..	32	6
Thyroidectomy	6	..	6	..
Genitourinary	5	1	4	..
Eye, ear, nose, throat, dental	44	24	20	..
Plastic	30	2	28	..
Orthopedic	38	11	27	..
Rectal	26	7	19	..
Total	306	87	199	20

* Surital followed by cyclopropane and/or nitrous oxide.

The introduction of a purified form of curare as a muscle relaxant by Griffith[1] in 1942 opened a new corridor for investigation and research by the chemist, pharmacologist and anesthesiologist. Since then several synthetic neuromuscular blocking agents have been synthesized. Examples are flaxedil,® mytolon chloride,® decamethonium bromide (syncurine®) and the like. These and other agents have received more or less wide clinical application, but none have been entirely free from various disadvantages or undesirable side effects.[2–8]

Recently a new ultrashort-acting depolarizing type of muscle relaxant was introduced to anesthesiology. This agent known as succinylcholine iodide was synthesized free of impurities in 1951 by Löw and Tammelin.[9] Later, a more desirable agent succinylcholine chloride (anectine®) was prepared.[10]

Pharmacology. Succinylcholine chloride inhibits neuromuscular transmission but its mode of action differs from that of curare or curare-like substances. The latter substances cause a neuromuscular block by raising the threshold value of acetylcholine.[11] Succinylcholine chloride on the other hand causes a neuromuscular block by exerting a depolarizing effect on the muscle fibers.[12,13]

Succinylcholine chloride also differs from the other muscle relaxants in that it is hydrolyzed by both the plasma cholinesterase (nonspecific cholinesterase) and the acetylcholinesterase (true cholinesterase).[14] This double enzymic hydrolysis assures brief duration of effect with a single intravenous dose of this agent.[15]

Total Series. Table 1 illustrates a summary of the 306 cases in which succinylcholine chloride was used intravenously for the purpose of inducing muscular relaxation during various surgical procedures. In eighty-seven cases surital sodium was the sole anesthetic agent; in 199 cases it was combined with "balanced anesthesia" (intravenous surital sodium as an induction agent followed by inhalation agents cyclopropane and/or nitrous oxide); in twenty

* From the Department of Anesthesiology, Conemaugh Valley Memorial Hospital, Johnstown, Pa.

cases it was administered to patients who had previously been given spinal anesthesia.

Endotracheal Intubation. Table II is a summary of the incidence of endotracheal intubation, with the various anesthetic procedures in this series utilizing succinylcholine chloride as a muscle-relaxing agent. An endotracheal tube was inserted in three (14 per cent) of the twenty patients in whom spinal anesthesia was employed. Ninety-six (68 per cent) of those patients receiving surital sodium and cyclopropane and thirty-two (55 per cent) of those receiving surital sodium and nitrous oxide were also intubated; and in the group in which surtial sodium was the sole anesthetic agent used, nineteen (22 per cent) patients were intubated.

TABLE II
ENDOTRACHEAL INTUBATION

Anesthetic Procedures	No. of Cases	No. of Cases Intubated	Percentage
Lumbar	20	3	14
Balanced*			
Surital and cyclopropane	141	96	68
Surital and nitrous oxide	58	32	55
Intravenous (surital)	87	19	22
Total	306	150	49

* In nine cases ether was also added.

Age Distribution. Table III illustrates a summary of the age distribution of the patients in this series who received succinylcholine chloride as a muscle relaxant agent. The youngest patient was a twenty-one month old girl. She was bronchoscoped for the removal of a foreign body from the right middle bronchus. Adequate anesthesia and excellent muscular relaxation was induced with surital sodium (60 mg.) followed with 10 mg. of succinylcholine chloride. The same dosage of both agents was repeated in four minutes. A short period of apnea followed the second administration of the aforementioned agents and slight cyanosis developed. This was quickly relieved by the application of a face mask and oxygen. Recovery was rapid and uneventful. The oldest patient in this series was an eighty-four year old man in whom a diagnostic bronchoscopic procedure and biopsy was carried out. Adequate anesthesia and excellent relaxation was obtained by the rapid intravenous administration of 30 mg. of succinylcholine chloride followed by 100 mg. of surital sodium. Recovery was rapid and uneventful.

TABLE III
AGE DISTRIBUTION

Ages (yr.)	No. of Cases	Percentage
1–10	15	5
11–20	52	17
21–50	181	59
51–70	50	16.5
71–90	8	2.5
Total	306	100

TECHNICS OF ADMINISTRATION

Intermittent Injection. Patients adequately premedicated with barbiturates, scopolamine® and demerol® are carried to the first or second plane of the third stage of anesthesia by the intravenous administration of a 2 per cent solution of surital sodium. The amount of intravenous anesthetic agent required to attain this depth of anesthesia varies with age, sex, build and reflex activity. In the average adult male approximately 400 mg. (20 cc. of 2 per cent solution) are required; in senile debilitated patients 200 to 300 mg. will suffice; while in robust young men 500 to 1,000 mg. may be required. Following the induction of anesthesia succinylcholine chloride is administered by rapid intravenous injection. The amount of this muscle relaxant also varies; as a general rule 30 mg. is sufficient in the average adult; 40 mg. may be required in the robust male; while 10 to 20 mg. will suffice in debilitated, senile adults and in children under ten years of age.

Fifteen to thirty seconds after the completion of the injection of succinylcholine chloride the vocal cords are visualized by direct laryngoscopy and an endotracheal tube, previously lubricated with an unguentum containing a local anesthetic in a non-oily base, is gently passed into the trachea. The predetermined gaseous anesthetic agents and/or oxygen are then administered through an endotracheal assembly or by face mask. Hereafter, 20 to 30 mg. of succinylcholine chloride are admin-

istered when required for muscular relaxation at three- to eight-minute intervals.

Apnea is induced in many cases following the administration of the surital sodium and the succinylcholine chloride; thus it is probably advisable to apply a face mask and perform artificial ventilation with oxygen for thirty to sixty seconds before inserting the endotracheal tube. This not only adds a safety factor by increasing the pulmonary oxygen reserve but also permits time for the agents administered to exert their maximum effect. It does not appear necessary to spray the larynx with a local anesthetic previous to intubation as the vocal cords are usually relaxed and frequently abducted.

As a general rule an intravenous infusion is started previous to the induction of anesthesia and the surital sodium and the succinylcholine chloride are injected through the rubber sleeve of the infusion set.

Continuous Intravenous Injection. The patients are anesthetized in the same manner as in the intermittent injection technic. Following laryngeal intubation a continuous intravenous drip of a 0.15–0.25 per cent solution of succinylcholine chloride in normal saline is connected to the infusion set by means of a small gauge needle (22–24). The required degree of muscular relaxation is obtained by regulation of the rate of flow of the succinylcholine chloride solution. The required rate of flow of this solution varies markedly but, as a general rule, thirty to sixty drops per minute result in adequate muscular relaxation without marked respiratory depression.

Combination with Longer Acting Muscle Relaxants. Patients are anesthetized and intubated as in the foregoing manner. Then 2 mg. of syncurine (decamethonium bromide) are injected intravenously. Thereafter, supplemental doses of syncurine 1–2 mg. are administered as required. However, for closure of the peritoneum or when muscle relaxation is required for a period less than ten minutes, 20 to 30 mg. of succinylcholine chloride are administered. No incidence of prolonged residual respiratory depression has occurred following this technic nor has any synergistic action been noted clinically.

In a small number of cases 30 mg. of succinylcholine chloride and 2 mg. of decamethonium bromide were administered simultaneously following the induction of anesthesia with surital sodium. This facilitated laryngeal intubation and induced excellent muscular relaxation but also increased the incidence of apnea. This or a similar technic will be reported after more clinical experience has been obtained.

Dosage. The dose of succinylcholine chloride administered in this series varied greatly, depending on such factors as the age, reflex activity and physical condition of the patients, as well as the nature and duration of the operative procedure and the type of anesthetic agent employed. The average dose of succinylcholine chloride for laryngeal intubation is 30 to 40 mg. This amount produced good relaxation of the musculature of jaw and larynx without respiratory arrest. Thereafter, satisfactory abdominal muscular relaxation is obtained in most cases with intermittent injection of 20 to 40 mg. Similarly 30 mg. of succinylcholine chloride usually induces adequate relaxation for peritoneal closure.

A larger total amount of succinylcholine chloride is usually required with the continuous injection technic than with the intermittent injection technic for similar operative procedures of equal duration conducted with the same anesthetic agent.

RESULTS

Muscular Twitchings. The rapid intravenous injection of 10 to 50 mg. of succinylcholine chloride frequently results in generalized fibrillary muscle twitchings. This is a harmless phenomenon which is frequently induced by other substances which possess a similar chemical structure. It is due to an initial stimulating effect of depolarizing compounds on skeletal muscle.[11,15] This phenomenon occurs in almost every instance in which succinylcholine chloride is administered previous to the intravenous anesthetic agent.

Muscular Relaxation. Clinically the muscles are affected in the same order and manner by succinylcholine chloride as by other curare preparations, i.e., muscles innervated by the cranial nerves are affected first followed by the peripheral muscles, the intercostal muscles and finally the diaphragm.[11]

Systemic Effects. Succinylcholine chloride appears to have no appreciable or significant effects on the blood pressure or pulse. In animals several thousand times the paralyzing dose has been administered without any

marked change in the blood pressure.[11] No allergic manifestations have been apparent in this series nor has there been any evidence of histamine release. There has been no bronchospasm, laryngospasm, increased salivation or urticaria. These findings are in accord with those reported by others.[11,15,16] In most cases the pulse rate is slightly increased. Clinically the autonomic nervous system appears to be unaffected by succinylcholine chloride. At the present time it appears as though this agent caused less depression of the central nervous system than do other muscle relaxants. This is evidenced by the fact that larger doses of surital sodium are required to produce comparable levels of anesthesia when succinylcholine chloride is used rather than syncurine or the other commonly used curare preparations.

The effect of succinylcholine chloride on the respiratory activity of an individual varies directly with the dose administered, as is found with other muscle relaxants. As a general rule the rate of respiration is increased while the depth of respiration is decreased. The incidence of postanesthetic respiratory depression in this series is lower than that encountered when other muscle relaxants are used in the same manner and under similar circumstances. Also it is clinically apparent that with comparable muscular relaxation there is less depression of tidal volume than encountered with other muscle relaxants. In this relatively small series of cases succinylcholine chloride maintained remarkably smooth respiratory activity.

OBSERVATIONS

The anesthetic agent employed is an important variable which must be carefully considered when evaluating a new muscle-relaxing agent. Surital sodium, the new intravenous ultrashort-acting anesthetic agent, which has been described previously differs from other intravenous anesthetics commonly used at the present time.[17,18] Briefly, surital sodium in comparable dosage produces less respiratory depression than pentothal® sodium; it also produces less hypersensitivity of the laryngeal and pharyngeal reflexes than does pentothal sodium and recovery from anesthesia is more rapid than from pentothal sodium. It is thus apparent that the clinical impressions gained when evaluating succinylcholine chloride during surital sodium anesthesia will be more favorable than those gained using this agent with pentothal sodium.

Advantages

In this small series of cases it appears that succinylcholine chloride because of its almost instantaneous onset of action as well as its rapid hydrolysis is particularly advantageous in the following circumstances or situations.

In respiratory emergencies (i.e., laryngospasm): 30 to 50 mg. of succinylcholine chloride enables intubation of the larynx within thirty seconds, thereby, facilitating the administration of oxygen. It was used successfully for this purpose in four cases in this series. A patient undergoing a gastrectomy anesthetized with continuous lumbar analgesia and kept asleep with a small amount of surital sodium suddenly regurgitated liquid gastric contents. Laryngospasm with cyanosis followed immediately. Following the administration of 30 mg. of succinylcholine chloride an endotracheal tube was passed without difficulty. The anesthesia course was uneventful thereafter and the surgeon was not even aware that laryngospasm had occurred. Laryngospasm which occurred during the induction phase of anesthesia due to excessive pulmonary secretions also was easily managed by laryngeal intubation following the administration of 30 mg. of succinylcholine chloride. In addition two patients placed in steep Trendelenburg position during surgery were easily and uneventfully intubated in the foregoing manner.

In various endoscopic procedures: bronchoscopy, for example, requires maximum muscular relaxation for a very short period of time in most instances. Succinylcholine chloride and surital sodium induce sufficient relaxation and depress bronchial and tracheolaryngeal reflexes without affecting spontaneous respiration in most cases. Following removal of the bronchoscope there was no incidence of severe laryngospasm. Recovery was rapid, relatively uneventful and there was no case of prolonged respiratory depression.

Anesthesia for bronchoscopy was conducted in the following manner: 30 to 40 mg. of succinylcholine chloride were administered rapidly followed by 100 mg. of surital sodium. When necessary approximately two-thirds of the initial dose of each agent was repeated as required. Local anesthesia of the larynx was not found to be necessary. Apnea and cyanosis

occurred much less frequently than with other general anesthesia technics. This phase will be the subject of a later report.

In laryngeal intubation previous to inhalation anesthesia: succinylcholine chloride decreased the duration of the induction period which increased the safety to the patient as well as saved valuable time. It was used in 150 cases for this purpose in this series. The vocal cords are less irritable and adduction of the cords is less common than with curare-pentothal combinations.

In manipulations: in these procedures maximum muscular relaxation is usually required for only a relatively short period of time and rapid return to normal is desirable, particularly since many of these cases are outpatients.

In supplementing spinal anesthesia: in these cases additional muscular relaxation is occasionally required in the last stages of a laparotomy for peritoneal closure. Under these circumstances relaxation is only desirable for a very short period of time. It was used for this purpose in twenty cases in this series. In no instance was there any evidence of postoperative depression. No evidence of succinylcholine chloride passing the placental barrier was encountered in six cases of cesarean sections. In each case the baby breathed spontaneously.

Probably one of the outstanding advantages of succinylcholine chloride is its controllability which permits rapid changes in the degree of muscular relaxation. This factor is particularly apparent when employing the continuous injection technic. In most instances, however, I believe that it is more practical to use the longer acting muscle relaxants for lengthy procedures reserving the succinylcholine chloride for the induction phase and terminal stages if necessary.

Succinylcholine chloride appears excellent as a muscle relaxant in children. It was only used in fifteen cases in this series which is too small a number to be conclusive but no incidence of severe respiratory depression or any other ill effect was noted; recovery was rapid and uneventful in each case. The youngest child, referred to previously, was twenty-one months old. Succinylcholine chloride is also well tolerated by senile poor risk patients.

Comments: The advantages of succinylcholine chloride are as follows: (1) very rapid production of maximum muscular relaxation (fifteen to thirty seconds); (2) the degree and extent of muscular relaxation can be accurately controlled with this agent; (3) clinically, at least, there appears to be a wider margin of safety between muscle relaxation and respiratory arrest than is the case with other muscle relaxants; and (4) it does not appear to have any undesirable side effects, other than those involving the respiratory system, and it is apparently rapidly hydrolyzed to harmless end products.

Disadvantages

No real disadvantage became apparent in this series but the fact that vigilance and careful attention must be paid to the administration of this muscle relaxant because of its potency and rapid hydrolysis might be considered by some to be a relative disadvantage.

CONCLUSION

In this series we encountered no neurologic sequelae and there were no deaths or any other postoperative toxic effects which could be attributed to succinylcholine chloride.

This small series indicates that succinylcholine chloride is an excellent muscle-relaxing agent which deserves more extensive investigation. I believe that in most respects it is superior to any other muscle relaxant available at the present time.

Addendum: This series in which succinylcholine chloride (anectine) was used as a muscle relaxant during anesthesia has been extended to include over 900 cases. No changes have been made in the technics of administration. In the last 500 cases, however, there has been a tendency to use slightly larger doses for laryngeal intubation, in most instances 40 to 50 mg. instead of 30 to 40 mg.

In this extended series our earlier clinical impressions were all corroborated and no neurologic sequelae, postoperative toxic effects or deaths were encountered which could be attributed to succinylcholine chloride.

REFERENCES

1. Griffith, H. R. and Johnson, G. E. The use of curare in general anesthesia. *Anesthesiology*, 3: 418–420, 1942.
2. Foldes, F. F. and Machaz, T. S. Syncurine (decamethonium-bromide): its use with pentothal sodium and nitrous oxideoxygen anesthesia in abdominal surgery. *Anesthesiology*, 12: 366–375, 1951.

3. Comroe, J. H. and Dripps, R. D. The histamine-like action of curare injected intracutaneously and intra-arterially in man. *Anesthesiology*, 7: 260–262, 1946.
4. Grob, D., Lilienthal, J. L. and Harvey, A. M. On certain vascular effects of curare in man: the "histamine" reaction. *Bull. Johns Hopkins Hosp.*, 80: 229–322, 1947.
5. Landmesser, G. M. A study of the broncho-constrictor and hypotensive action of curarizing agents. *Anesthesiology*, 8: 506–523, 1947.
6. Harris, L. C. and Dripps, R. D. Use of deca-methonium bromide for the production of muscular relaxation. *Anesthesiology*, 11: 215–233, 1950.
7. Hunter, A. R. A study of a new relaxant drug. *Anaestbesia*, 7: 145–150, 1952.
8. Dundee, J. W. et al. Win 2747—relaxant agent. *Anaestbesia*, 7: 134–144, 1952.
9. Löw, H. and Tammelin, L. E. *Nord. Med.*, 46: 1043, 1951; *Acta physiol. Scandinav.*, 23: 78, 1951.
10. Adamson, D. C. and Kinsman, F. M. Succinyl choline chloride in anaesthesia. *Anaestbesia*, 7: 166–168, 1952.
11. Dardel, O. V. and Thesleff, S. Clinical experience with succinyl-choline-iodide, a new muscular relaxant. *Anestb. & Analg.*, 31: 250–257, 1952.
12. Thesleff, S. Pharmacological and clinical tests with L. T. I (o.o-succinylcholine iodide). *Nord. med.*, 46: 1045, 1951.
13. Dardel, O. V. and Thesleff, S. Clinical results with succinylcholine iodide, a new muscle relaxant. *Nord. med.*, 46: 1308–1311, 1951.
14. Bovet-Nitti, F. Degradazione di alcune sostanze curarizzanti per azione di coliiesterasi. *Rendic. Ist. super. san.*, 12: 139–157, 1949.
15. Foldes, F. F., NcNall, P. G. and Borrego-Hinojosa, J. M. Succinylcholine dichloride, a new approach to muscular relaxation in anesthesiology. To be published.
16. Castillo, J. C. and de Beer, E. J. Neuromuscular blocking action of succinylcholine (diacetylcholine). *J. Pharmacol. & Exper. Therap.*, 99: 458–464, 1950.
17. Lund, P. C. Surital sodium, a new intravenous anesthetic agent. *Am. J. Surg.*, 81: 637–641, 1951.
18. Lund, P. C. Surital sodium intravenous anesthesia, 6,000 consecutive cases. To be published.

HEPATOMA

REPORT OF AN UNUSUAL CASE COMPLICATED BY SUBPHRENIC HEMORRHAGE

JOSEPH A. LAZARUS, M.D. AND FRIEDRICH FRIEDMANN, M.D.
New York, New York

HEPATOMA, as the term denotes, is a primary tumor of the liver arising from the organ cells, which differentiates it from cholangioma which takes origin from the epithelial lining of the bile ducts.

Ewing placed hepatoma in the general category of neoplastic hyperplasia which he subdivided into (1) adenoma, (2) adenocarcinoma and (3) carcinoma (solitary, multiple and atypical). Because the vast majority of hepatomas are malignant, this report will be confined to this category.

Up to August, 1937, 1,125 cases were reported.[13] Orth reported four cases from a collected group of 258 hepatic carcinomas (0.28 per cent). Goldzieher and Bokay found eighteen cases among 6,000 autopsies (1.3 per cent) over a period of five years. Of 3,300 autopsies performed at the Middlesex Hospital, forty-one (1.2 per cent) were of the variety in question.[12]

The incidence of primary carcinoma of the liver is extremely low in Occidentals (0.14 to 0.6 per cent) as disclosed in a review of a large series of routine autopsies.[31] A higher incidence in a series of autopsies upon 585 Chinese, 35 of whom showed primary hepatic carcinoma.[14] The incidence is relatively high in certain regions of South Africa, Japan, Asia and the Philippines.[54] These investigators found that of a group of twelve, ten were Chinese. Tull was able to study 134 examples from a group of 17,664 autopsies performed in Singapore (0.76 per cent), or one example of primary carcinoma of the liver in every 716 autopsies. Kika assembled 110 cases from autopsy material at the Pathological Institute of Tokyo. Out of a series of ninety-seven autopsies (death from carcinoma) in South Africa, there were thirty-six primary carcinomas of the liver.[42] Of 4,544 consecutive autopsies at the Grasslands Hospital, there were eighteen examples (0.39 per cent) according to Heffner, et al.[31]

While cholangiomas occur more frequently in women, the incidence of hepatoma is by far of greater prevalence in men. In Heffner's series, all eighteen cases were in men, twelve tumors being hepatomas and six cholangiomas.

As in all carcinomas, the disease is far more prevalent in persons over the age of forty. According to Ewing, tumors arising in the intrahepatic biliary ducts occur later in life than the hepatomas and are rarely seen before the age of forty. Yamagiwa, Griffith, Dansie, Sawyer, Beynon, Andriotakis, etc., reported several cases in children. For example, Dansie was able to collect reports of twenty-five tumors in children less than two and a half years of age, while Griffith studied fifty-seven in children under sixteen years. Muller reported a primary carcinoma of the liver in an eighty-three year old man.

PATHOLOGY

While Van Heukelom was the first to point out the relationship of hepatoma to hypertrophic cords of liver cells, it was Goldzieher and Bokay who subsequently described the relationship most fully. Evidence was brought forward which clearly showed a uniform transition from the stage of nodular hyperplasia to multiple adenomas to the final stage of multiple carcinoma, stages of a process which were demonstrated in the same liver.[22,23] Although the hypothesis has been advanced that many hepatomas arise from multiple foci, Ribbert and Heussi are not in accord with this view.

During the transitional change between hyperplasia and neoplasm of liver cells, the cells may retain their granules, even though they may stain more intensely with basic dyes. At other times the liver cell loses its granules and pigment and becomes transparent, which has led to the belief that the tumor may be of embryonic origin.[1] As the anaplastic process of the cell increases it loses its ability to secrete bile. A characteristic feature of the hepatoma cell is the unusual enlargement of its nucleus and its tendency to stain deeply. Giant cells containing multiple

nuclei are common and mitosis and amitosis are frequent features. In the early stages of development the cells of hepatoma tend to be large, but later become smaller and less typical. Ewing described an interesting feature of hepatoma, namely, the tendency of preservation of liver capillaries and the development of new ones.

Metastases. Although early invasion of capillaries by tumor cells is characteristic of hepatoma, the development of distant metastases is uncommon. The reason for this phenomenon is the apparent failure of tumor thrombi to survive after being carried to extraneous tissue. However, the tendency to form local metastases is common. Large tumor thrombi have been found in the portal and hepatic veins;[20,41,43] in fact, cases have been reported in which these thrombi have passed from the vena cava into the heart,[5,14,43,59] and in one example involved trunks of the right pulmonary artery.[48] Extension of tumor thrombi into intrahepatic radicals of the biliary tree have also been reported.[2] A case of invasion of the cystic duct by tumor has been reported.[43] Skeletal metastases have been described in a few reports.[4,9,14,30,52,55,56] Nevertheless it can be stated that distant metastases are relatively rare. In Eggel's 163 collected cases, forty-six showed no extension; in fifty it was confined to the portal and hepatic veins, while in thirty metastases were localized in lungs and thorax and in eighteen in regional lymph nodes. In only nine were distant metastases found.

Specimens of bile production by cancer cells have been demonstrated in distant metastases.[29,50] The histologic conformation of distant metastatic implants frequently shows cords of hepatic cells, with Kupfer cells and capillaries.

Pathologic Variations of Hepatomas. According to Ewing, hepatomas may be classified as: (1) solitary adenomas which are rare;[19,46,47,58] (2) primary massive malignant hepatomas. Although this variety may occur among young adults, it is more common in elderly patients. The tumor usually occurs as a single, large, soft, friable mass which may occupy an entire lobe of the liver and may be associated with several small secondary tumors. There is a great tendency to invade veins; and when metastases are found, they are usually bulky, especially when situated in the lungs.

Multiple hepatomas. This form is highly malignant and tends to grow rapidly. Unlike the other two varieties, the liver in this group may show little or no evidence of cirrhosis. The organ is most frequently enlarged, especially in an upward direction, so that the right diaphragm is usually greatly elevated. Of 134 cases, Tull found the diaphragm elevated in fifty-two.

Patients presenting tumors falling within this category are usually beyond middle age, although there have been reports of the condition in infants and older children (DeHaan, Mair, etc.).

The liver is usually enlarged. The involvement consists of multiple grayish, bile- or blood-stained nodules or masses, with or without necrosis. This kind of tumor is less prone to metastasize to distant organs, but local extension to regional lymph nodes, diaphragm and gallbladder is quite common. When metastases are extensive, the liver has commonly been found to be cirrhotic.

Carcinomatous cirrhosis: This condition occasionally has been designated multiple liver adenomas, carcinoma or hepatoma.[25,29,47]

Tumors belonging in this category all show progressive invasive tendencies and may or may not be associated with cirrhosis. In the presence of cirrhosis there seems to be a direct relationship between it and the growth.

These neoplasms occur in persons past forty years of age, but have been found in children with no antecedent history of illness. In the vast majority of patients a history of preexistent cirrhosis has been elicited.

The liver may be enlarged, of normal size or small. On section one sees numerous projecting yellowish (bile-stained) discrete nodes or the section may disclose a large, encapsulated tumor. It has been estimated that approximately 20 per cent of these neoplasms metastasize to the lungs and peritoneal lymph nodes.[10,29]

Relationship between Hepatoma and Cirrhosis of Liver and Other Conditions. According to Yamagiwa and Eggel, 80 to 100 per cent of hepatomas are associated with cirrhosis, while 50 per cent of cholangiomas show cirrhosis. Counseller is so firmly convinced of this relationship that he makes no diagnosis in the absence of cirrhosis. Blumenau found that 3.5 per cent of 198 examples of liver cirrhosis had primary carcinoma of the liver. According to Heffner et al., primary carcinoma of the liver is twenty-five times more prevalent among

persons suffering from cirrhosis than in the general population and are of the opinion that cirrhosis may in some way stimulate the action of carcinogenic agents. Many primary liver carcinomas have accidentally been found at autopsy in persons dead of cirrhosis.

Cirrhosis is usually of the portal or biliary variety owing to alcohol or syphilis. Lohlein and Rindfleisch reported a primary liver carcinoma associated with hemochromatosis. Echinococcic cysts, distomiasis and schistosomiasis have also been found associate lesions.[17,36,39,60]

Clinical Manifestations. Anemia, rapid weight loss and gastrointestinal symptoms (diarrhea, nausea, etc.) are frequently found in this condition. Yet, Rolleston reported cases in which despite the presence of a rapidly growing tumor, patients gained several pounds in weight. Fever is a common symptom, especially in rapidly growing tumors (14 per cent),[18] and is more prevalent in cholangiomas than in hepatomas.[31] Jaundice has been reported in 61 per cent of cases collected by Eggel, while ascites was present in 58.5 per cent. In Heffner's series ascites was discovered in fifteen of eighteen patients.

On the other hand, tumors have been reported in asymptomatic patients. For example, Karsner wrote of a patient with a large hepatoma, who died suddenly after a short illness. As previously mentioned, there have been many reports of tumors discovered at autopsy in persons who died of cirrhosis. In several, symptoms appeared two weeks to six months before death (as shown by Eggel in a study of fourteen patients ranging in age from twenty-one to sixty-seven years). Ewing reported the condition of an old man who died suddenly from an intra-abdominal hemorrhage attributable to an unrecognized hepatoma. There have been other reports of severe intra-abdominal hemorrhages resulting from these tumors.[37,53]

According to Heffner, pain is an early symptom and is usually localized to the right upper quadrant, lower thorax and high in the lumbar area, and is caused by stretching of Glisson's capsule.

Icterus is not an early symptom, but it may appear in many patients before death.[31]

In regard to the importance of laboratory tests as an aid in diagnosis, the most reliable is liver biopsy which is positive in 75 to 80 per cent of cases.[31] This investigator also places great emphasis upon the serum alkaline phosphatase level. Figures over 10 Bodansky units, especially in patients without icterus, he considers highly suggestive. Gutman also places great reliance upon this test.

Prognosis. Following recognition of the tumor, the average life expectancy has been found to be four months.[28] Although recovery is very rare, examples of apparent cure have been reported following surgical excision of the tumor.[34,61] The clinical course following recognition of the growth is often extremely rapid, some patients living only a few weeks.

Treatment. The only form of treatment with the slightest chance of success is surgical removal of the tumor with an adequate amount of contiguous liver tissue, which is not only feasible but has been proved successful on several occasions.[6,11,21,37] Keen was able to collect seventy-six reports of liver resection for tumor, with sixty-three recoveries and a mortality rate of only 14.9 per cent. Deep roentgen therapy has been ineffective.

CASE REPORT

Mrs. D. M., sixty-two years of age, a housewife, was first seen in 1921 when the appendix and right ovary were removed for chronic appendicitis and ovarian cyst. Nine years later cholecystectomy was done for chronic cholecystitis and lithiasis. In 1934 a posterior gastrojejunostomy was carried out for a stenosing duodenal ulcer. She was asymptomatic until September, 1947, when returned because of a steadily growing mass in the right lower abdomen. Examination disclosed a large tumor involving the right lobe of the liver, extending down to the pelvis. Operation under spinal anesthesia revealed an enormous blood-filled cystic tumor with fibrosis and calcification of its wall, involving the undersurface of the right lobe of the liver. This was completely excised. The pathologic report stated: "Benign adenomatous liver cyst showing (a) marked hemorrhage into lumen, (b) marked fibrosis of wall, (c) focal calcification within wall."

Several months after the last named operation she began to complain of pain in the right loin and frequent bouts of urinary discomfort and pyuria. Urologic examination disclosed a chronic pyelonephritis and a sinus tract leading from one of the calices of the kidney to the right lobe of the liver. A subcapsular nephrectomy was accomplished on January 3, 1949.

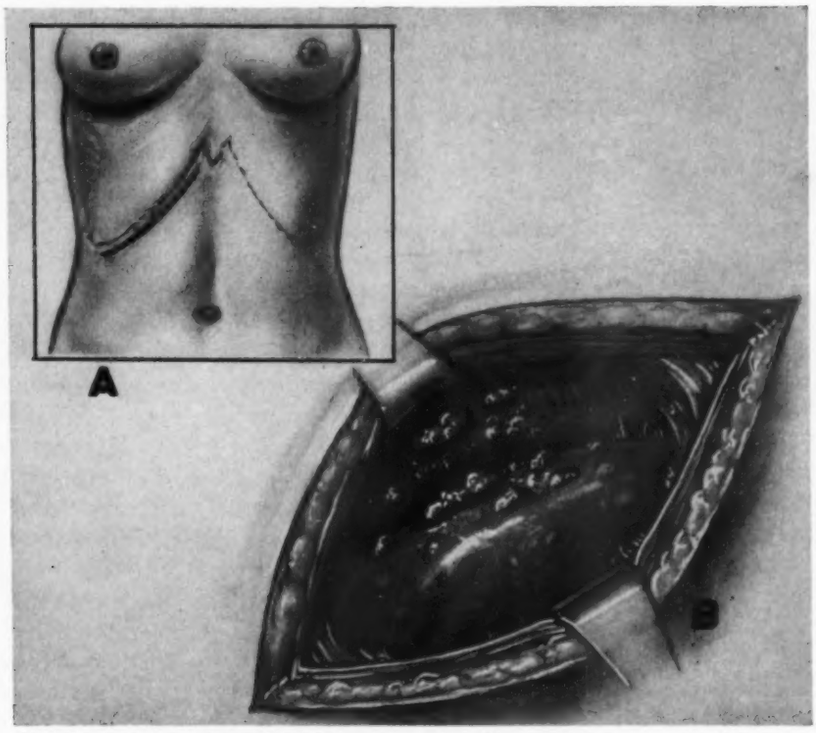


FIG. 1. A, right subcostal incision. B, right subphrenic space exposed showing lesions on diaphragm and dome of liver found at first operation.

She returned in July, 1949, complaining of pain in the right upper abdomen, anorexia and weight loss. There was dyspnea on slight exertion. Examination was essentially negative except for tenderness over both loins and to the right of the umbilicus. On January 15, 1952, she reported pain in the right upper abdominal quadrant radiating to the back and aggravated by deep inspiration, persisting for two weeks and urelated to food.

Examination disclosed severe tenderness in the right upper quadrant of the abdomen. The chest revealed nothing abnormal; blood pressure was 170/90; rectal temperature 100.6°F. The skin showed deep icteric tinge. Roentgenograms of the chest showed great elevation of the right leaf of the diaphragm.

Laboratory data were as follows: Urine negative for bile and urobilinogen; icterus index 3.8 units; bromsulphalein 13 per cent retention in thirty minutes; cephalin flocculation, a trace in twenty-four and forty-eight hours; blood cholesterol 215 mg. per cent; hemoglobin 66.7 per cent; white blood cells 10,350.

One week later the patient developed acute phlebitis of the right leg which responded to rest and anticoagulants.

One week after discharge from the hospital she experienced an attack of syncope. Examination two days later disclosed an area of dullness over the right lower chest posteriorly with diminished breath sounds over the right base. Flat roentgenogram of the abdomen showed a cluster of shadows in the area of the right lobe of the liver just below the tip of the twelfth rib, and elevation of the right hemidiaphragm.

Urinalysis showed a trace of bile. Hemoglobin was 53.8 per cent; white blood cells 16,850, with normal differential count; sedimentation rate 31 mm/hour (Cutler). Diagnosis: Suphrenic abscess.

On February 9, 1952, under intratracheal, gas-ether and sodium pentothal anesthesia, through a long right subcostal incision, the right subphrenic space was entered, disclosing an enormous cavity filled with free blood and clots. After evacuating the contents of the subphrenic space, several soft, grayish-pink, nodular masses covered by organized clots were seen attached to the undersurface of the diaphragm and also to the dome of the right lobe of the liver. (Fig. 1.) The peritoneal cavity was completely sealed off by adhesions binding the right hepatic lobe to the anterior abdominal wall. Representative specimens from the dia-

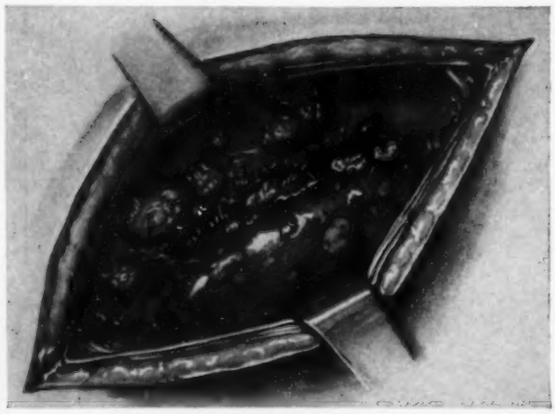


FIG. 2. Right subphrenic space exposed showing extent of involvement at second operation.

phragm and liver were excised for biopsy. The subphrenic space was drained and the wound closed in layers.

The pathologic report stated: "Nondescript hemorrhagic tissue containing chalky-white fibrous friable areas. Microscopic: hepatoma showing necrosis, interstitial hemorrhage and adjacent fibrosis."

Postsurgical convalescence was uneventful. The patient was discharged on February 23, 1952. On March 5, 1952, the patient felt well; hemoglobin was 86.1 per cent; red blood cells 4,310,000; white blood cells 14,150 with normal differential count. Fluoroscopy of the chest showed considerable elevation of the right leaf of the diaphragm and greatly reduced respiratory excursions. There was a small collection of fluid in the right costophrenic angle.

When examined four weeks later the patient again complained of pain in the right upper quadrant of the abdomen. She had had a temperature of 101°F. for several days. Pain grew progressively more intense. Examination disclosed a hard nodule to the right of the xyphoid. Fluoroscopy showed extreme elevation of the right hemidiaphragm with restriction of motion.

On April 14, 1952, under intratracheal anesthesia the right subphrenic space was entered through the previous subcostal scar and found to contain a great amount of old blood and clots. Many tumor masses, ranging in size from that of large English walnuts to that of hazel nuts, studded the undersurface of the diaphragm to which they were attached by broad pedicles. (Fig. 2.) The tumors were of hard rubber consistency, friable, and the cut surface was yellowish-gray. Tumors of similar character were present on the surface and in the substance of the right hepatic lobe. They were slightly smaller than those present on the diaphragm, ranging in size from hazel nuts to small peas. While most of the tumors were discrete, a few appeared to be confluent.

Representative sections were taken for biopsy from tumors involving the diaphragm and liver. As many of the tumors as could be reached were thoroughly electrocoagulated. After draining the subphrenic space, the wound was closed in layers.

Blood was replaced by transfusion and the patient was discharged from the hospital in twelve days.

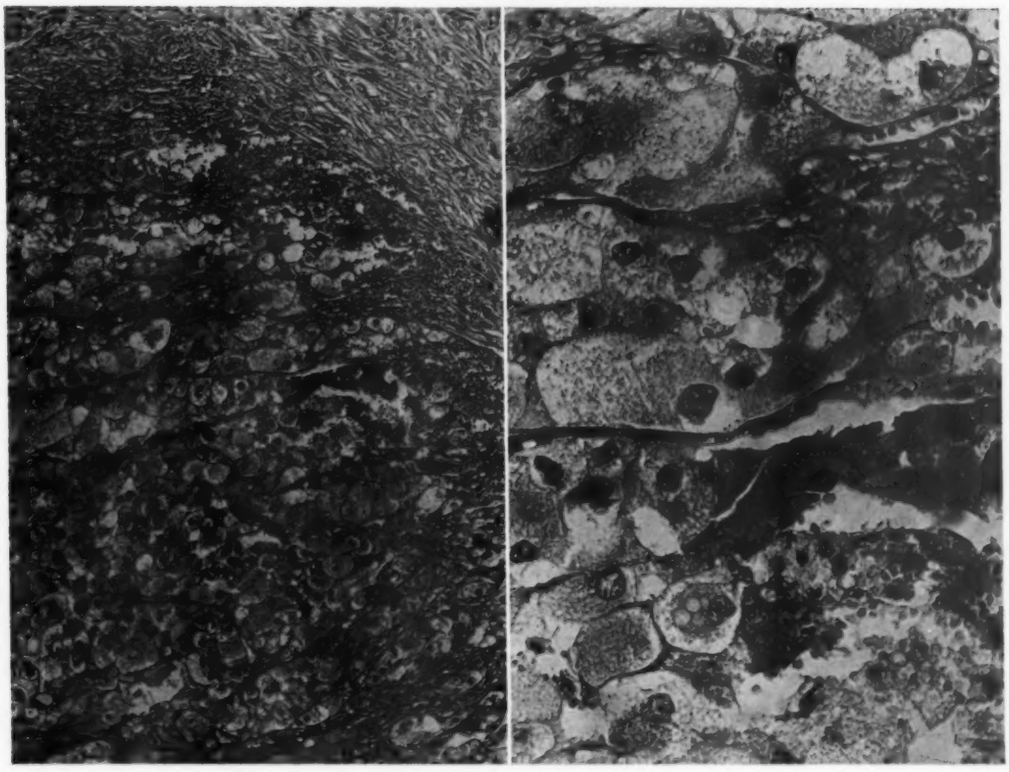
The pathological report stated that the portion of tissue obtained from the liver contained grape-sized, white tumor nodules; the specimen from the diaphragm, was pink, friable tumor tissue. Microscopically, the lesions obtained from the liver were "partly encapsulated infiltrating hepatomas"; those from the diaphragm, "metastatic infiltrating hepatomas." (Figs. 3 and 4.)

Testosterone was administered in large doses and deep roentgen therapy applied for pain. On this routine the patient gained 10 pounds in weight, but still complained of pain in the right upper quadrant. She developed massive metastases to the left lung and left hemothorax, requiring frequent aspirations, and also massive infiltration of the liver which could be seen and palpated in the epigastrium. She expired October 21, 1952, eight and a half months following the first exploration of the subphrenic space.

COMMENT

Hepatoma is a primary tumor arising from hepatic cells and is usually malignant. Its close association with cirrhosis has long been recognized. While the disease is most prevalent in persons past forty years of age, it is not too uncommonly found in infants and young children.

Although early invasion of capillaries by tumor cells is characteristic of hepatoma, the development of distant metastases is not common because of difficulty of tumor thrombi to survive in tissues distant from the liver. Local metastases in the liver and contiguous structures, on the contrary, are frequently seen. Hepatomas may arise as primary massive



3 4

FIG. 3. Photomicrograph (× 133) showing clusters of pale polygonal cells resembling liver cells. The normal cord arrangement of liver cells, however, is absent. Tumor cells appear fairly regular (typical of hepatoma).

FIG. 4. Photomicrograph (× 533) showing polygonal tumor cells resembling liver cells. These show some resemblance to cells of the adrenal. The cell grouping is irregular instead of strand-like. Most cells reveal no mitosis but contain single or double nuclei, some of which are hyperchromic. Note the regularity of the cells.

tumors, as multiple tumors, or as "carcinomatous cirrhosis."

Anemia, fever, pain, rapid weight loss and gastrointestinal symptoms are frequent clinical manifestations of the disease. Yet it may progress asymptomatically, aside from the signs attributable to an underlying cirrhosis. Ascites has been reported in more than 50 per cent of patients. Sudden severe intra-abdominal hemorrhage may occasionally be suggestive of the disease. Pain localized in the right upper abdominal quadrant is usually an early symptom. While most patients are icteric before death, it is not an early sign. A frequent indication on fluoroscopy is extreme elevation of the right hemidiaphragm.

The only reliable diagnostic laboratory test is liver biopsy which has been reported as positive in 75 to 80 per cent of cases. Average life expectancy following diagnosis is usually four months, although recovery has been reported following surgical removal of a solitary tumor.

CONCLUSIONS

While hepatoma, a malignant growth arising from hepatic cells, is not an extremely rare disease, its recognition during life may be extremely difficult because of: (1) absence of, or minimal clinical manifestations, or (2) overriding symptoms and signs from a pre-existent cirrhosis so frequently associated with the disease. Except for complete surgical removal which is possible in only a few selected patients, there is no specific treatment. Average span of life following recognition is approximately four to five months.

A case is reported of hepatoma occurring in a woman who, five years previously, had an enormous hemorrhagic adenomatous cyst removed from the right lobe of the liver. Although

right upper abdominal pain, loss of weight, mild icterus and extreme elevation of the right hemidiaphragm were noted, it was sudden collapse caused by a massive subphrenic hemorrhage that lead to exploration and diagnosis. Because the lesions were discrete tumors involving the dome of the right lobe of the liver and the undersurface of the diaphragm, we concluded that they belonged to Ewing's classification of multiple hepatomas.

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REFERENCES

1. Adler, L. *Beitr. z. path. Anat.*, 35: 127, 1904.
2. Aird, I. *Ann. Surg.*, 136: 27, 1952.
3. Andriotakis, C. N. and Cambylafka, M. J. *Presse méd.*, 55: 263, 1947.
4. Auerbach, O. and Trubowitz, S. *Cancer*, 3: 837, 1950.
5. Barry, M. W. and Russum, B. C. *Nebraska M. J.*, 16: 312, 1931.
6. Bean, L. L. *Ann. West. Med. & Surg.*, 3: 391, 1949.
7. Beynon, A. E. *Lancet*, 2: 528, 1948.
8. Blumenau, E. *Arch. f. Verdauungsk.*, 27: 1, 1920.
9. Bolker, J., Jacobi, M. and Koven, M. T. *Ann. Int. Med.*, 10: 1213, 1937.
10. Brissaud, E. *Arch. gén. de méd.*, 2: 129, 1885.
11. Brunschwig, A. *J. A. M. A.*, 136: 28, 1948.
12. Calwell, H. *Arch. Middlesex Hosp.*, 5: 122, 1905.
13. Charache, H. *Am. J. Surg.*, 43: 96, 1939.
14. Counseller, V. S. and McIndoe, A. H. *Arch. Int. Med.*, 37: 363, 1926.
15. Dansie, C. B. *Lancet*, 2: 228, 1929.
16. DeHaan, J. *Beitr. z. path. Anat.*, 34: 215, 1903.
17. Dibbelt, W. Inaug. Dissert., Greifswald, 1903.
18. Eggel, H. *Beitr. z. path. Anat.*, 30: 506, 1901.
19. Engelhardt, A. *Deutsche Arch. f. klin. Med.*, 60: 607, 1897.
20. Ewing, J. Neoplastic Diseases, 2nd ed., pp. 675–678. Philadelphia, 1922. W. B. Saunders Co.
21. Freeman, B. S. and Moreland, R. B. *Ann. Surg.*, 127: 1240, 1948.
22. Fried, B. B. *Am. J. M. Sc.*, 168: 242, 1924.
23. Glynn, E. *Brit. M. J.*, 11: 1192, 1911.
24. Goldzieher, M. and Bokay, Z. *Virchows Arch. f. path. Anat.*, 203: 75, 1911.
25. Griesinger, W. *Arch. f. Heilk.*, 5: 385, 1864.
26. Griffith, J. F. C. *Am. J. M. Sc.*, 160: 79, 1918.
27. Gutman, A. B., Olson, K. B., Gutman, E. B. and Flood, C. A. *J. Clin. Investigation*, 19: 129, 1940.
28. Hale White, W. Allbutts System of Medicine, 2nd ed., vol. 4, p. 215. New York, 1910. Macmillan.
29. Handt, V. and Gilbert, A. Paris, 1888. Asselm & Houzeau.
30. Hedrick, D. W. *J. Bone & Joint Surg.*, 19: 817, 1937.
31. Heffner, R. R. and Swingler, R. *New York State J. Med.*, 51: 2123, 1951.
32. Heussi, P. Inaugural Dissertation, Zürich, 1898.
33. Karsner, H. T. *Arch. Int. Med.*, 8: 238, 1911.
34. Keen, W. W. *Ann. Surg.*, 30: 267, 1899.
35. Kika, G. *Gann*, 23: 107, 1929.
36. Loehlein, W. *Beitr. z. Path. Anat.*, 42: 531, 1907.
37. Mazingarbe, A. *Mém. Acad. de chir.*, 76: 627, 1950.
38. Muller, W. *Zentralbl. f. allg. u. path. Anat.*, 61: 161, 1932.
39. Necker, F. *Ztschr. f. Heilk.*, 6: 351, 1905.
40. Orth, M. Ueber Leberkarzinome. Strassburg, 1885.
41. Peasley, E. D. *Bull. Truesdale Hosp.*, 5: 25, 1931.
42. Pirie, J. H. *M. J. So. Africa*, 17: 87, 1921.
43. Report Mass. Gen. Hosp., Case 34011, *New Eng. J. Med.*, 238: 25, 1948; Case 35422, 241: 622, 1949; Case 33441, 237: 673, 1947.
44. Ribbert, M. W. H. Lehrb. d. allg. Path. u. der path. Anat., Leipsig, 1920. F. C. Vogel.
45. Rindfleisch, G. E. *Münchcn. med. Wchnschr.*, 48: 283, 1901.
46. Rokitansky, C. *Allg. Wien. med. Ztschr.*, 4: 98, 1859.
47. Rolleston, H. D. Diseases of Liver, Gall Bladder and Bile Ducts, p. 468. Philadelphia, 1905. W. B. Saunders and Co.
48. Salviati, L. *Arch. "de Vecchi" anat. path.*, 11: 911, 1948.
49. Sawyer, C. D. *J. Pediat.*, 36: 508, 1950.
50. Schmidt, M. B. *Arch. f. path. Anat. u. Physiol.*, 148: 43, 1897.
51. Siegenbeck van Heukelom, D. E. *Beitr. z. path. Anat. u. z. allg. Path.*, 16: 341, 1894.
52. Smith, K. J. *J. Lab. & Clin. Med.*, 18: 915, 1932.
53. Specter, J. and Chodoff, R. J. *Surgery*, 3: 391, 1949.
54. Strong, G. F., Pitts, H. H. and McPhee, J. G. *Ann. Int. Med.*, 30: 791, 1949.
55. Surbek, K. E. and Vos, J. J. *J. Th. Geneeskijdschr. v. Nederl.-Indie*, 75: 239, 1935.
56. Thomson, S. A. *Canad. M. A. J.*, 32: 675, 1935.
57. Tull, J. C. *J. Path. & Bact.*, 35: 557, 1932.
58. Wegelin, C. Die Krebsk. und ihre Bekämpfung, vier Vorträge. Bern, 1918.
59. Winternitz, M. C. *Bull. Johns Hopkins Hosp.*, 17: 143, 1916.
60. Yamagiwa, K. *Virchows Arch. f. Path. Anat.*, 206: 437, 1911.
61. Yeomans, F. J. *J. A. M. A.*, 64: 1301, 1915.

A NEW AUREOMYCIN DRESSING*

RATIONALE AND USE IN THE TREATMENT OF SURFACE WOUNDS

JOSEPH A. TAMERIN, M.D., WILLIAM I. METZGER, PH.D. AND LOUIS T. WRIGHT, M.D.†

New York, New York

THIS paper presents the results of a study of the use of a new antibiotic dressing in the treatment of surface wounds such as burns, skin graft donor sites, abrasions, excoriations, avulsions and ulcers. Such wounds, expecially if they involve a large area, present a special problem from the standpoint of control of infection and early closure. Systemic antibiotic therapy is not ideally suited for the treatment of local infections because effective concentrations of the drug are often not obtainable locally. Moreover, the possibility of side reactions and the cost of treatment are disadvantages to prolonged systemic therapy. If infection can be controlled and healing promoted by local therapy, considerable advantage may be gained.

There are several antibacterial agents that can be used on the skin; there are fewer that can be effectively and safely used in a wound. For example, the mercurials can be used on the skin but in wounds they are subject to inactivation by serum proteins.[1] The more active chemical antiseptics interfere with wound healing and epithelization.[2] In more recent years the sulfonamides, the development of which inaugurated a new era in systemic antisepsis, were also advocated for topical application. They were finally largely discarded for this use, however, because of their sensitizing effect and especially with sodium salts like sodium sulfadiazine, because of their interference with epithelization, likely in part due to their marked alkalinity. They may also adversely affect urinary output. Penicillin has also been used to a considerable extent locally, but reactions have been observed frequently[3] and it is relatively unstable, being subject to destruction by bacterial enzymes and otherwise. Furthermore, it is quite restricted in its antibacterial activity as compared to the newer, broad spectrum antibiotics. Topical antibacterial therapy in wounds thus has left something to be desired up to the present time.

RATIONALE OF LOCAL AUREOMYCIN THERAPY

The development of aureomycin affords a new approach in the field of local antibacterial therapy for the following reasons: (1) the drug is substantially non-sensitizing;[4] (2) it has as broad an antibacterial spectrum as any other known safe drug; (3) to date the development of bacterial resistance to this drug has been relatively uncommon; (4) it is relatively stable in appropriate vehicles and is not destroyed by bacterial enzymes; (5) it is of benefit in various pyogenic and other infections of the skin and thus may control dermatoses often seen at wound edges;[4] (6) in proper usage it does not irritate or interfere with wound healing and epithelization.

One of the developments in local therapy is an aureomycin dressing‡ (8 by 12 inches) comprising 44 by 36 mesh sterile surgical gauze impregnated with a base of bland hydrocarbon oils, cholesterol esters and a creaming agent, and containing a dispersion of micropulverized aureomycin hydrochloride (320 mg. per dressing). The base will absorb water to form a stabilized cream or emulsion. It thus tends to keep the wound dry and consequently to avoid maceration. Suitable compounding of the ingredients yields a base that does not become too thin during use and does not disperse too readily, thus minimizing sticking to the wound with consequent disruption upon removal, and avoiding abrasion of the healing wound which may destroy new epithelium. Agar plate

‡ Supplied by Davis & Geck, Inc., a unit of American Cyanamid Co., Brooklyn, N. Y.

* From the Surgical Service of Harlem Hospital, Department of Hospitals, New York, N. Y. This investigation was supported, in part, by a grant from the Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

† Deceased.

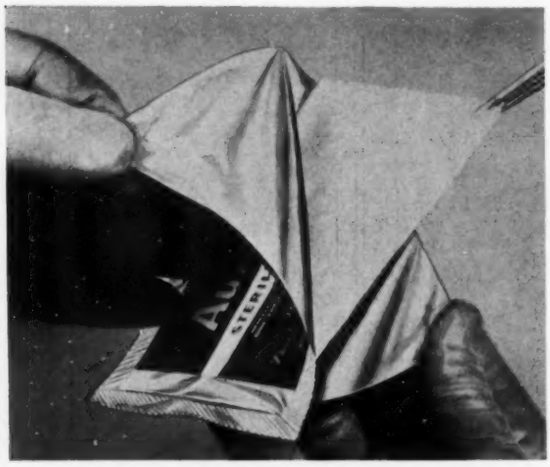


FIG. 1. Aureomycin dressing being removed from the aluminum foil envelope. The envelope is laminated internally to a plastic film.

tests with this ointment base and with other comparable bases, using a variety of test organisms, showed that the present base gave a better release of aureomycin than did various other possible bases of this general type. The ointment without aureomycin gave no zones in control tests.[5] Skin toxicity tests, according to the procedure of Gradwohl,[6] using rabbits, showed no irritation and no leukocytic response to this dressing upon abraded areas.[7] Such dressings are prepared by a special technic that assures a high degree of sterility of the aureomycin with consequent little loss of potency when the dressing is packaged in a container providing protection against atmospheric moisture. (Fig. 1.) Not only may the dressing be used therapeutically, but it may also be used prophylactically as an original dressing on clean wounds or to prevent spread of contamination that may occur subsequently. The use of this dressing does not eliminate the need for other necessary procedures such as débridement and cleansing of the wound, skin grafting in full thickness wounds when indicated, and systemic use of antibiotics in the presence of invasive infection. The dressing is relatively economical as compared to systemic therapy and is more convenient than other types of local treatment, such as wet dressing technics.

Severely injured or extensively burned patients will require hospitalization, but in a busy municipal hospital where the incidence of injury is high, we have been compelled to devise a routine that permits the treatment of all cases of minor surface injuries on an ambulatory basis. This is not to say that the wounds we see are not contaminated or even infected. For example, in a series of seventy-seven cases seen over a three-month period 65 per cent were found to be contaminated with potentially pathogenic bacteria. These wounds were seen at various intervals after the time of injury and, as would be expected, the neglected ones were the most contaminated. Invasive infection was noted upon occasion but, in general, the cases treated in the outpatient department did not suffer generalized infection and did not need systemic antibiotic therapy. Hospitalized patients, on the other hand, being more severely injured, were given systemic antibiotics routinely as a prophylactic measure. When needed, however, oral antibiotic therapy was prescribed for ambulatory patients if there was evidence of invasive infection.

The following case in our present series is illustrative:

M. L., age twenty-nine, was burned by hot grease on the dorsal surface of the right forearm on March 30, 1951. She treated herself at home and was first seen in the outpatient department five days later, with an irregular wound measuring roughly 4 by 7 cm. The wound was sensitive and from gross inspection was a moderately deep second degree burn. There was a halo of inflammation surrounding the burn to an extent in some areas of almost 3 cm. This area was swollen, hot and painful, and represented unmistakable evidence of invasive infection. There was a tender node in the right axilla, rectal temperature was 101°F. and wound culture revealed beta hemolytic streptococci and non-hemolytic Staphylococcus albus. The burn wound was covered with the aureomycin dressing and the patient was given eight capsules of aureomycin (enough for forty-eight hours) to be taken at home, 250 mg. four times a day. She was seen again on April 5, 1951, seven days post-burn and two days following the initiation of aureomycin therapy. The temperature was now 98.6°F., the axillary node was no longer palpable and all evidence of invasive infection had disappeared, but the wound culture still revealed beta hemolytic streptococci and non-hemolytic S. albus, the same two organisms as on the previous culture. Systemic aureomycin therapy was discontinued, but the wound was redressed with the aureomycin gauze. On April 10, 1951, twelve days post-burn, the wound culture showed only

non-hemolytic S. albus and the wound was almost healed with the exception of a few small areas. On this visit the wound was covered again with the aureomycin dressing. On April 17, 1951, nineteen days post-burn, the wound was completely healed and the patient was discharged.

This case demonstrates the control of invasive infection by oral therapy and the control of local infection by topical therapy. It also demonstrates the persistence of pathogenic bacteria locally despite systemic therapy. The streptococci which cause clinically harmful effects on burns[8] were brought under control by a combination of the therapeutic routes.

Control of infection is particularly important in partial skin thickness injuries since infection may destroy remaining epithelial elements, thus converting partial thickness into full thickness wounds. In full thickness injuries in which much debris remains on the wound it is important to control the growth of saprophytic organisms as well as those bacteria which will interfere with the take of skin grafts and epithelial growth. In the presence of such cellular detritus and exudate cleansing, more frequent redressing and control of bacterial action are all important aspects of management in order to provide early a suitable base for skin grafting and closure.

RESULTS OF BACTERIOLOGIC STUDIES

While we do not believe it is always necessary to sterilize open wounds, and such vigorous measures may often retard healing, we do believe it is important at least to control the growth of organisms which may become invasive or interfere with epithelization and delay skin grafting. We have made extensive bacteriologic studies during the course of treatment with the aureomycin dressing in order to demonstrate the type of bacteriologic control obtainable with this preparation. These studies consisted in identification of micro-organisms in cultures taken from the wounds when first seen and during the course of treatment, which included weekly or in some cases semi-weekly changes of the aureomycin dressing.

The precise method of obtaining bacteriologic cultures in these cases was as follows. Each wound was sampled with one or two sterile cotton swabs. These were streaked over the entirety of small wounds but, of necessity, only the particularly necrotic or inflamed areas of larger wounds were swabbed. The swabs were placed immediately in fluid thioglycolate broth and incubated at 37°C. for forty-eight hours. At this time the gram stains were made and a loopful of the broth was streaked on appropriate aerobic or anaerobic agar plates. Isolated colonies were then subcultured for further identification or in some cases for *in vitro* sensitivity tests.

TABLE 1
RELATIVE PREVALENCE OF BACTERIA IN WOUNDS WHEN FIRST SEEN

	Per cent
Non-hemolytic S. albus	66.0
Non-hemolytic streptococcus	33.8
Beta hemolytic streptococcus	18.2
Bacillus sporogenes	15.6
Proteus sporogenes	14.3
Hemolytic S. albus	13.0
Heomolytic S. aureus	11.7
Aerobacter aerogenes	11.7
Pseudomonas sporogenes	10.4
Alpha hemolytic streptococcus	7.8
Diphtheroids	6.5
Non-hemolytic S. aureus	3.9
Microaerophilic staphylococcus	3.9
Paracolon bacillus	3.9
Escherichia coli	2.6
Clostridium sporogenes	1.3
Neisseria sporogenes	1.3

Table 1 shows the relative prevalence of the various bacteria in the wounds before treatment in the seventy-seven cases (sixty-five burns, twelve ulcers).

In only four cases were the first cultures negative. In 65 per cent of these seventy-seven cases the first culture showed contamination with one or more of the following organisms which we have classified as potentially pathogenic: alpha hemolytic streptococcus, beta hemolytic streptococcus, hemolytic S. aureus, non-hemolytic S. aureus, microaerophilic staphylococcus, E. coli, A. aerogenes, paracolon bacillus, and Cl. sporogenes. Of the thirty-three cases contaminated with potentially pathogenic organisms which could be followed up bacteriologically, 45 per cent showed complete elimination of these organisms during treatment with the aureomycin dressing. Ps. sporogenes (pyocyanea), an organism normally classified as resistant to aureomycin and one of the saprophytes common in "dirty" wounds presumed responsible for the foul odor often characteristic of deep burns, was found in 10.4 per cent of these cases and was eliminated in each case, although it showed considerable persistence in

two cases. Pr. sporogenes also normally classified as resistant to aureomycin was eliminated in four of eleven cases. The elimination of these resistant organisms may be due to the relatively high concentrations of aureomycin obtainable with the dressing. It may be presumed that bacterial growth was depressed even in cases in which the organism was not eliminated. It is interesting to note that the resistant monilia organism was found in only one culture of the total of 376 cultures examined from the seventy-seven cases and it did not persist in subsequent cultures from this case. An added observation made during the course of these bacteriologic studies was that bacterial resistance was not a factor following the use of topical aureomycin.

It would, of course, be desirable in such a study to determine the relative population of the various bacteria at different stages of treatment. This, however, presents considerable difficulty. Another problem in a study of this type is concerned with the sampling procedure. When a fairly large area is involved, the flora of one particular site may not be representative of the flora at large. On the other hand a too enthusiastic sampling technic may be harmful in unduly disturbing the wound and spreading organisms from one area to another. Also, since most of these patients were ambulatory, other intangible factors are introduced, such as poor contact between dressing and wound, shifting of the dressing and re-contamination.

CLINICAL EVALUATIONS

The profusion of preparations and procedures which have been recommended for the local treatment of burns attests to the continuing search for a simple yet effective method for the management of burns and other surface wounds.

Like many others, for many years we have attempted to assay the therapeutic value of many types of dressings and ointments for surface wounds, as well as their complete avoidance (the exposure method). One fact emerges from such studies, namely, that the results are usually qualitative, not quantitative. In spite of elaborate and ingenious technics the rate and extent of wound healing cannot be quantitatively measured in absolute terms of clinical significance. Hence it has not been our intention to assay the effect of this aureomycin dressing on wound healing in a quantitative sense. However, after experience in the use of over 2,000 of these dressings on hundreds of burns and other open wounds, we believe that the wounds heal kindly under the dressing and that these dressings serve as an essential adjunct to our armamentarium in the management of large surface wounds. Our studies on the subject are continuing.

In the management of burns and other wounds healing is the primary desideratum, not sterilization of the wound. In our experiences in the use of aureomycin dressing healing progressed satisfactorily in every instance in spite of the existence of contamination, in many of our cases with potentially pathogenic bacteria, when the wounds were first seen by us. This experience indicated to us that (1) the aureomycin dressing in no instance interfered with wound healing and, in fact, in many cases promoted it, presumably due to control of infection, to the control of the spread of re-contamination and to avoidance of abrasion and disruption of the healing wound; and (2) the drug used locally in this type of dosage form resulted in no untoward reactions and no contraindications were observed in its use on any type of open wound as compared to the use of any other type of dressing available to us.

It is not our purpose in this paper to discuss the relative merits of the closed versus the open treatment of burns. The recent revival of interest in the open (exposure) treatment of burns is commendable when one realizes the need for such management, at least temporarily, in the event of a disaster where the materials for closed treatment (dressings) will not be immediately available. From the clinical material presented by those working on this problem, it would seem that a desirable aspect of the exposure technic in the treatment of extensive burns can be ascribed to the suppression of bacterial activity by the drying effect of the air. Even here, however, local application of antibiotics has been practiced.[9] The point is stressed that a quagmire of bacterial activity may be setup under a closed dressing of the usual type. On the debit side of the exposure treatment one must note that patients must be hospitalized and that sometimes elaborate nursing and mechanical suspension technics are required to keep clothes and bed sheets off the wound. Also, adequate warmth and clean air should be provided.

The exposure treatment is obviously impractical with the ambulatory patient. Since the largest number of patients at this hospital (and others) are ambulatory, they are seen and dressed at weekly or occasionally at semiweekly intervals in the outpatient department. We rarely admit patients to the inpatient wards unless skin grafting is contemplated. Exceptions to this rule would be patients with extensive partial thickness burns (second degree) or with burns of the lower extremity which do poorly on an ambulatory regimen.

The use of the aureomycin dressing in single thickness, covered with a soft, absorbent overlying dressing applied with moderate uniform pressure will tend to keep the wound dry in all except profusely suppurating wounds. In the latter cases more frequent dressing and cleansing of the wound may be resorted to, if required, and pus-forming organisms will thus be subject to control by the aureomycin. We are not aware of an experimental technic whereby maceration may be quantitatively estimated, but it was our impression during the clinical evaluation of this dressing that maceration was retarded.

The aureomycin dressing, sterilized and packaged as it is, offers the additional advantage of availability of a dressing at any place and time. Many dressings are bulky or require personal autoclaving and pharmaceutic procedures. They are not readily transportable and cannot be carried easily in one's bag or car, or stored in one's office or medicine cabinet. This dressing is simple and available for use.

We have used the aureomycin dressing on hundreds of skin graft donor sites, as well as over grafted areas. The healing of donor sites should theoretically offer an ideal testing area for the study of wound healing and it is our impression that the donor sites have healed with unusual rapidity, although quantitative evaluation of this is impossible. Actually the unavoidable variation in the depth of excision, the variation in skin thickness in different areas and in different subjects, the variation in the natural healing components and the unavoidable bacterial contamination are liable to infinite combinations. Each undoubtedly affects the healing of the wound and hence renders a strictly comparable series almost impossible to obtain. Nevertheless the unavoidable bacterial contamination of the donor sites is sufficiently obvious to suggest the logic of our observation that our donor sites healed more kindly in the resurfacing of extensive third degree wounds when dressed with the aureomycin preparation. While it is, of course, highly desirable to avoid contamination of the donor sites from the burn wound, it is often impractical to isolate the removal of the skin and its application to the recipient area by separate instrument setups and otherwise, and to dress the donor site before application of the grafts to the burn wound. Often the use of skin adjacent to the burn is desired for the skin grafting. This may be because there is no other skin available or it may be because one is impelled to limit the trauma from both donor and recipient areas to the same locale. Under such circumstances contamination of the donor site is unavoidable. While we have not made a specific bacteriologic study of the point, our experience with the excision of burns[10] show that in spite of elaborate precautions spilling of bacteria from the surface of the burn to the healthy tissue beneath the excision invariably occurs. Hence we welcome the added safeguard of an effective antibiotic dressing on unavoidably contaminated areas, particularly since our experiences in the use of the aureomycin dressing have revealed no instance of interference with wound healing in use of over 2,000 dressings.

An additional use of the dressing in the resurfacing of third degree (full thickness) burns was as a backing for patch grafts as well as a dressing over the entire recipient area.

SUMMARY

1. Bacteriologic study of 376 cultures from seventy-seven cases, including sixty-five burns and twelve ulcers, showed the relative prevalence of the various bacteria in these wounds before and during the course of treatment with a new aureomycin dressing and demonstrated suppression by the dressing of the growth of pathogenic or potentially pathogenic organisms. It may be presumed that high concentration levels of aureomycin, locally obtainable from the dressing, also resulted in suppression of certain bacteria normally classified as resistant to the drug.

2. In the use of over 2,000 aureomycin dressings on a large variety of surface wounds, including burns, skin graft donor and recipient areas, avulsions, abrasions and ulcers, no untoward reactions and no interference with wound healing were observed. No other contraindica-

tions were noted by us as compared to use of any other dressing available.

3. It is our impression that wounds healed with unusual rapidity under the aureomycin dressing, as one might expect when infection is controlled and in the absence of any chemical effect that would retard epithelization.

4. Skin graft donor sites unavoidably contaminated by adjacent burn wounds healed with unusual rapidity under the aureomycin dressing.

5. The aureomycin dressing affords a convenient, readily available dressing offering an extra safeguard against the development of infection, which is an ever present possibility in spite of the best possible aseptic technics.

REFERENCES

1. McCulloch, E. C. Disinfection and Sterilization, 2nd ed., p. 268. Philadelphia, 1946. Lea & Febiger.
2. Estes, W. L., Jr. The use of antiseptics in the treatment of open wounds. *Am. J. Surg.*, 47: 369–374, 1940.
3. Kitchen, D. K., Rein, C. R., Thomas, E. W. and Spoor, H. J. Reactions to penicillin. *Am. J. Syph., Gonor. & Ven. Dis.*, 35: 578–582, 1951.
4. Sawicky, H. H., Pascher, F., Frank, L. and Rosenberg, B. Therapeutic assays of the skin and cancer unit of the New York University Hospital. Assay iv. Aureomycin hydrochloride ointment. *J. Invest. Dermat.*, 15: 339–341, 1950.
5. Dornbush, A. C. Personal communication. The Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.
6. Gradwohl, R. B. H. Clinical Laboratory Methods and Diagnosis, 4th ed. vol. 1, p. 1200. St. Louis, 1948. The C. V. Mosby Company.
7. Corbett, J. J. Personal communication. The Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.
8. Jackson, D. M., Lowbury, E. J. L. and Topley, E. Chemotherapy of streptococcus pyogenes infection of burns. *Lancet*, 2: 705–711, 1951.
9. Colebrook, L. Symposium on Burns, p. 125. Nat. Res. Council, Nat. Acad. Sc., Washington, D. C., 1951.
10. Wright, L. T., Tamerin, J. A., Metzger, W. I. and Garnes, A. L. Aureomycin as an adjunct in the treatment of major burns. *Surgery*, 29: 763–771, 1951.

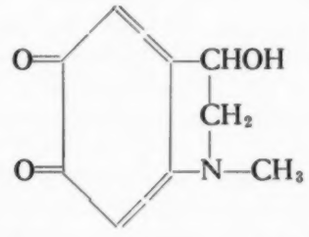
THE CONTROL OF BLEEDING

DANIEL A. SHERBER, M.D.
New Rochelle, New York

THE observation that the intravenous injection of small doses of adrenalin resulted in a shortening of bleeding time[1] prompted Derouaux and Roskam to conduct further investigation on the hemostatic activity of sympatheticomimetic compounds. Subsequently, Derouaux demonstrated that with rare exceptions all sympatheticomimetic amines shortened bleeding time when administered intravenously in appropriate doses. This effect did not occur immediately but was noted from fifteen minutes to six hours after the injection of the amines.[2–7] Upon further investigation Derouaux[8] demonstrated that the two principal oxidation products of adrenalin, namely, adrenochrome (which has no sympatheticomimetic properties) and adrenoxine (which is a vasodilator) have prompt hemostatic activity. Neither is there a latent period for such activity to take effect as is true of other sympatheticomimetic amines.

On the basis of the reports discussed above and because of the inadequacy of available therapeutic measures, a clinical trial of adrenochrome as a hemostatic agent was undertaken.

As already noted adrenochrome is an oxidation product of adrenalin and has the formula



Adrenochrome is a very unstable product. It has been found, however, that certain derivatives of adrenorchrome, particularly the monosemicarbazone and the mono-oxime, are very stable products in the dry form or in aqueous solutions. The aqueous solutions can be heated to boiling without decomposition. These materials, however, are only slightly soluble in water, about 0.05 per cent at 20°C. Stable aqueous solutions of much higher concentrations of adrenochrome monosemicarbazone and monooxime, suitable for oral or parenteral administration, may be prepared by using sodium salicylate as a solubilizing agent.* This combination will subsequently be referred to as adrenochromazone complex.†

This adrenochrome derivative gave no evidence of toxicity in laboratory animals. Patients treated with daily doses of adrenosem for as long as eighteen months demonstrated no toxic effects attributable to the drug.

The patients studied in this preliminary report were taken from the private practice of the author and interested colleagues, and may be grouped under two broad categories: (1) diseases associated with defects in the anatomic and/or physiologic integrity of the vasculature; (2) surgical cases.

Dosage. With active bleeding, when possible, the patient was given 5 mg. adrenochromazone complex intramuscularly every two hours until there was a definite diminution in the bleeding. When facilities for parenteral therapy were not available, or when bleeding was not too active, oral therapy was instituted in doses ranging from 1 mg. to 5 mg. every two to four hours, again depending upon the severity of the clinical manifestation.

A total of seventy-seven patients were treated with adrenochromazone complex in amounts ranging from a single 5 mg, parenteral dose to continuous treatment with combined oral and parenteral therapy for a period up to eighteen months. Subjects were chosen for treatment because their bleeding could be attributed to one of the two general categories mentioned previously. Since this is a preliminary study on the clinical evaluation of adrenochromazone complex, the results that follow cannot be analyzed statistically, but an appraisal of such a limited though varied group will give some indication as to the therapeutic value of this adrenochrome derivative. There were thirty-four patients in the group with bleeding related to surgical conditions, and

* Fleischhacker, D. and Barsel, N.—US 2,581,850.

† Adrenosem® was supplied by The S. E. Massengill Co., Bristol, Tenn.

forty-three patients in the category with bleeding associated with some vascular defect.

In the latter group the patients were divided as follows: hypertension, seven; unclassified purpura, seven; pulmonary bleeding, sixteen; familial hereditary telangiectasis, three; gastrointestinal bleeding, six; miscellaneous, four.

The first group consisted of seven patients with hypertension, all of whom manifested some evidence of bleeding. Four patients had hemorrhagic retinitis—in one of whom it occurred in conjunction with papilledema. Two patients in this group had subarachnoid hemorrhages, and one patient had severe epistaxis. The dose in this group varied from 5 mg. every two hours intramuscularly for two days, to 5 mg. daily in divided doses taken orally. In cases in which there was active bleeding, as in subarachnoid bleeding and epistaxis, prompt cessation of bleeding was noted shortly after the institution of therapy. In one patient with subarachnoid bleeding and in the patient with epistaxis bleeding recurred when treatment was discontinued but ceased promptly with reinstitution of therapy with the adrenochromazone complex. All of the patients in this group had normal bleeding and clotting times prior to onset of treatment. During course of treatment no change was noted in these values.

CLINICAL OBSERVATIONS

Group I. Hypertension: Because of the interesting aspects of these cases a brief summary of the clinical features of one of them is presented.

L. F. was a forty-five year old white man with malignant hypertension characterized by retinal hemorrhages, papilledema and evidence of progressive azotemia. He was troubled with frequent episodes of epistaxis, bleeding from posterior pharyngeal wall and episodes of hematuria. Urologic investigation revealed varices in the neck of the urinary bladder.

Prior to the initiation of treatment with adrenochrome derivative epistaxis and hematuria were frequent. Hematuria, once manifest, would persist on an average of five to six days. Epistaxis was frequent and would at times last eighteen to thirty-six hours. A complete eye examination made before starting treatment revealed retinal hemorrhages and papilledema.

This patient was started on oral adrenochromazone complex therapy, 1 mg. tablet four times daily. While on this regimen the patient had one episode of hematuria, small in amount, lasting four hours. Bleeding stopped promptly and completely when the patient took two additional 1 mg. tablets. This episode was the first evidence of bleeding after eight months on oral adrenosem medication. Gross hematuria was not again evident during the patient's lifetime.

After nine months of medication the patient again suffered an episode of epistaxis which stopped promptly after taking two additional 1 mg. tablets of the adrenochrome derivative. Unfortunately, the patient was in another city and these were the last tablets in his possession. The epistaxis recurred and continued for eighteen hours, after which it stopped spontaneously.

After having been on adrenochromazone complex medication for six months, this patient's fundi were checked by his ophthalmologist who reported that the hemorrhages and papilledema recorded previously were no longer evident. There was no change noted in the appearance of the retinal vessels, in spite of the fact that there was no change in the patient's blood pressure, subjective symptoms and evidence of progressive renal failure during this period. The patient died nineteen months later of uremia.

Group II. Purpura hemorrhagica: There were seven patients with purpuric manifestations in this group. Six of these patients had purpuric skin manifestations, without abnormal hematologic findings. These patients received 1 mg. tablets three times daily. All of the patients recovered. It would be very difficult to evaluate the role of the medication in these six patients. The clinical details of the following case of purpura hemorrhagica are presented briefly.

M. G., a sixteen year old white girl, was seen with profuse vaginal and urinary bleeding, and a profound anemia secondary to this condition. Diagnostic studies, including complete blood and sternal marrow studies, failed to reveal any abnormality other than that due to anemia secondary to a marked loss of blood.

The patient received many transfusions, large doses of rutin and vitamins C and K but continued to bleed. In spite of adequate platelets splenectomy was performed as a desperate measure. The skin wound could not be closed at operation because of persistent oozing and had to be packed.

Because of the persistence of oozing in the operative wound adrenosem, 5 mg. intramuscularly every two hours, was started on the second day postoperatively. This dose was continued for twelve days, so that during this period the patient received 720 mg. of the material intramuscularly. Thirty-six hours after the institution of therapy a firm clot was present in the operative wound and all bleeding ceased.

After the first twelve days of therapy the dosage was quickly reduced and the patient was discharged asymptomatic three weeks after the operation.

Group III. Pulmonary bleeding: There were sixteen patients in this group. These patients could be classified into the following categories: exudative and fibrocavernous tuberculosis, eight patients; bronchiectasis, four patients; mitral stenosis, one patient; hemoptysis, cause undetermined, three patients. Parenteral and oral therapy were instituted and in all instances bleeding stopped, adrenochromazone complex being used as the sole therapeutic agent. The following clinical abstract is presented:

T. Q., a fifty-five year old white man, had continuous pulmonary bleeding for six weeks, varying in character from minimal to severe moderate, with no cessation. The patient required numerous transfusions. Clinical diagnosis was mitral stenosis. The patient was started on adrenochromazone therapy, 5 mg. intramuscularly, every two hours. In all, he received ten doses parenterally. All evidence of bleeding stopped within twenty-four hours. Following parenteral therapy the patient received 2 mg. orally every two hours for twelve doses.

The patient was free of all evidence of bleeding for two weeks, at the end of which time bleeding recurred. Parenteral therapy was again instituted, 5 mg. intramuscularly, every three hours for six doses, and bleeding stopped within eighteen hours.

Bleeding recurred three weeks later, with minimal intensity. At this time two doses of 5 mg., intramuscularly, were sufficient to control the bleeding.

Recurrence of rheumatic fever and cerebral embolism occurred and personality changes developed to an extent requiring removal of the patient to a psychiatric institution, where he died of other causes.

Group IV. Familial bereditary telangiectasis: Three members of a family with this disorder were treated with adrenochromazone complex. A brief clinical summary of one of these is presented:

A. M. was a fifty-eight year old white woman, one of a large family, most of whom were afflicted with familial hereditary telangiectasis. The patient's paternal grandmother had died of bleeding. Her father died of a pulmonary hemorrhage. One brother had died of bleeding, and another was still living and troubled with epistaxis and gastrointestinal bleeding. One sister, who demonstrated no hemorrhagic tendencies, was living.

The patient's chief complaint was epistaxis, daily in occurrence, lasting an average of twenty minutes. These episodes were usually terminated by packing the nares. The patient was unable to blow her nose for fear of causing further bleeding and had required many transfusions.

Physical examination revealed numerous telangiectasis on the palms of the hands, fingers, skin of face, chest, upper areas and tongue. The nares were filled with clotted blood. Blood pressure was 140/90; blood count revealed a mild hypochromic anemia; bleeding and clotting time was normal; erythrocyte sedimentation (Westergren) 40 mm. per hour.

The patient was started on oral treatment, 1 mg. tablet, three times a day. She persisted on this regimen for four weeks and during this period did not have a single bleeding episode. She was also able to clear her nose during this period without causing bleeding. At the end of this time her allotment of tablets were finished. Two days later daily episodes of epistaxis promptly recurred.

Group V. Gastrointestinal bleeding: Six patients were seen with bleeding from the gastrointestinal tract. One patient with a diagnosis of esophageal bleeding received 5 mg. intramuscularly every four hours for six doses. The patient's bleeding stopped after the first injection. Two patients were treated for bleeding from peptic ulcers. These patients were treated with transfusion and diet, in addition to supplemental therapy were adreno-sal. One patient received 1 mg. intramuscularly, every six hours for four doses, and bleeding stopped within twenty-four hours. The second patient received 2 mg. intramuscularly, every four

hours for six doses, and bleeding stopped within forty-eight hours.

Group VI. Miscellaneous: There were four patients in this group with unrelated conditions. One patient with cirrhosis of the liver presented bleeding into the skin and from the gum. Capillary fragility in this patient, as measured by the Gothlin method, was increased. This patient received 5 mg. intramuscularly, every three hours, and bleeding stopped after the second injection. The Gothiin index was not influenced by this treatment.

One patient had congenital telangiectasis with severe bleeding from rectum and colon. This patient received one 5 mg. dose daily, intramuscularly. During the three-week period that the adrenochrome derivative was administered there was complete control of the bleeding. There was no recurrence of bleeding until two or three weeks after the treatment was stopped.

One patient in this group was treated for bleeding from the rectal mucosa. This patient received several doses of 2 to 5 mg. intramuscularly with prompt cessation of bleeding.

Two patients with hemophilia were treated for bleeding, with doses varying from 0.5 mg. to 5 mg. intramuscularly. In one of these patients with hematuria 1.0 and 2 mg. intramuscularly, every four hours, seemed to have an effect on the renal bleeding.

Surgical Patients. Thirty-four were studied, using the adrenochrome derivative either prophylactically or therapeutically for bleeding secondary to surgical procedures. Eight of the patients received one injection of 5 mg. intramuscularly, prior to tonsillectomy and adenoidectomy. None of these patients had postoperative bleeding.

Eleven patients received one dose of 5 mg. intramuscularly, as treatment for bleeding following tonsillectomy and adenoidectomy. In two patients the dose was 0.5 mg. and was ineffectual, so that other measures were required to arrest bleeding. The remaining nine patients received doses ranging from 2 mg. to 5 mg. In all instances bleeding stopped within fifteen minutes.

One patient demonstrated a moderate amount of oozing of blood from cigarette drain following a cholecystectomy. The patient received one injection of 5 mg. intramuscularly, and all evidence of bleeding stopped within the hour.

Four patients were treated who had had epistaxis severe enough to require surgical intervention. Bleeding had continued after surgery. These patients were given one to two injections of 5 mg. intramuscularly, at three-hour intervals, and in all instances there was no bleeding evident after the last dose.

Five patients with surgical genitourinary conditions, complicated by bleeding, were treated with adrenochromazone complex.

Two patients had bleeding following transurethral prostatic resections. One of these received two doses of 5 mg. intramuscularly, two hours apart. Twenty minutes after the first injection bleeding was negligible. The other patient received one dose of 5 mg. intramuscularly, with no apparent effect.

There were two patients whose postoperative course following prostatectomy was complicated by bleeding. One of these was a patient with carcinoma of the prostate who bled for three months, requiring numerous transfusions. This patient received 5 mg. intramuscularly every three hours for three days. Bleeding ceased completely after the third injection. The second patient had postoperative bleeding which was not influenced by one 5 mg. dose given intramuscularly.

One patient in this group had an ulceration of the bladder neck associated with hematuria. This patient was given oral therapy, 1 mg. four times daily. While under treatment hematuria was no longer manifest.

Two patients with bleeding following pelvic surgery were treated with the adrenochrome derivative. One of these was bleeding vaginally, following a hysterectomy. One 5 mg. dose intramuscularly, was followed by cessation of bleeding in forty minutes.

The second patient in this group continued to bleed following a diagnostic currettage. The surgeon believed he had abraded a submucous fibroid. Bleeding ceased almost completely following a 5 mg. injection given intramuscularly.

The adrenochromazone complex, in single 5 mg. doses, was given intramuscularly with uncertain results in postoperative hemorrhage following amputation, in a bullet wound resulting in internal hemorrhage and in a stab wound.

CONCLUSION

Although it would be impossible to establish absolute controls in this type of survey, it appears from the cases reported that the adrenochrome derivative is a potent anti-

hemorrhagic factor in those conditions in which the integrity of the smaller vessels is interrupted, and is superior to any similar material that is now available.

From our experience it appears that adrenochromazone complex is indicated in preventing vascular accidents incident to hypertension; in maintaining small vessel integrity; in the preoperative preparation where oozing from a vascular bed is anticipated, as in tonsillectomies, adenoidectomies and prostatectomies; and as an adjunct in the treatment of bleeding from such surgical procedures.

SUMMARY

1. The adrenochromazone complex was used clinically on seventy-seven patients whose condition was characterized by bleeding either secondary to a defect in the anatomic and/or physiologic integrity of the vasculature, as in hypertensive retinitis and hereditary familial telangiectasis, or in cases in which there was a traumatic interruption of vascular integrity following surgery and trauma.

2. The drug is non-toxic for man in the doses reported. From our experience it appears that doses of less than 5 mg. either orally or parenterally are of dubious value.

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REFERENCES

1. Derouaux, G. and Roskam, J. Adrenaline, adrenalone, and mean bleeding time. *J. Physiol.*, 90: 65, 1937.
2. Derouaux, G. Action les amines sympathicométiques sur l'hémostase spontanée. *Arch. internat. de pharmacodyn. et de thérap.*, 65: 125, 1941.
3. Derouaux, G. Etude du mécanisme de l'action hemostatique de l'adrénaline. *Arch. internat. de pharmacodyn. et de thérap.*, 66: 202, 1941.
4. Derouaux, G. Etude du temps de saignement dans deux etats physiopathologiques expérimentaux: l'anémie post-hémorragique et les convulsions. *Arch. internat. de physiol.*, 51: 269, 1941.
5. Derouaux, G. Actions des poisons sympathicolytiques et adrénolytiques sur le temps de saignement. *Arch. internat. de pharmacodyn. et de thérap.*, 66: 231, 1941.
6. Derouaux, G. Les medications hemostatiques. *Verbandel. k. Vlaamsche Acad. Geneesk. v. Belgie*, 4: 95, 1942.
7. Derouaux, G. Nouvelles recherches sur l'action hemostatique des amines. *Arch. internat. de pharmacodyn. et de thérap.*, 68: 311, 1942.
8. Roskam, J. and Derouaux, G. Interprétation de l'action hémostatique générale des substances sympathicommetiques et théorie des transmissions neuro-humorales. *Arch. internat. de pharmacodyn. et de thérap.*, 69: 348, 1944.
9. Cahill, J. D. Personal communication to the author.
10. Moolten, S. E. Personal communication to the author.

Obstetric Clinic

THE woman about to become a mother or with a new-born infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden, or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly or selfishly.

OLIVER WENDELL HOLMES

14th and last of the Series

ACCIDENTS OF LABOR*

CHARLES A. GORDON M.D.

Professor Emeritus of Obstetrics and Cynecology, State University of New York College of Medicine (New York City)

ALEXANDER H. ROSENTHAL, M.D. AND JAMES L. O'LEARY, M.D.

Clinical Associate Professor in Obstetrics and Gynecology, State University of New York, College of Medicine (New York City)

Attending Obstetrician and Gynecologist, St. Catherine's Hospital

Brooklyn, New York

ACCIDENTS of labor continue to contribute a considerable percentage to the maternal death rate. In our previous clinics on rupture of the uterus, postpartum hemorrhage and anesthesia many of the common adversities of labor have been discussed. Now our purpose is to comment upon some of the less frequent complications of labor such as transverse presentation, prolapse of the cord, inversion of the uterus and failed forceps. In their management by version and extraction, forceps, craniotomy, Dührssen's incisions and the like, art often outstrips science. It will never be otherwise.

CASE I. A twenty-nine year old gravida III, para I entered the hospital at term with uterine contractions every three minutes, intact membranes and a bloody show. Her prenatal course had been uneventful. Four years before she had been delivered of a 9 pound, 9 ounce baby by forceps rotation and extraction after fifteen hours of labor.

The vertex was unengaged, the cervix 5 cm. dilated and thick. Since the baby appeared to be large, x-ray pelvimetry was performed. The roentgenologist reported no cephalopelvic disproportion and classified the pelvis as gynecoid.

Two hours later contractions were strong and regular, so demerol, 100 mg., and scopolamine, $\frac{1}{150}$ gr., were administered intravenously. On vaginal examination the cervix was found to be 8 cm. dilated and still thick. During this examination the membranes ruptured and the vertex descended to the ischial spines. After two hours of full dilatation, vaginal examination found the vertex in L. O. T. position with considerable caput formation. It was estimated that the vertex was at or just below the spines. Under cyclopropane anesthesia, after manual rotation failed, Kielland's forceps were applied but neither rotation nor descent could be effected. Internal podalic version was then performed and a 9 pound, 8 ounce stillborn fetus was extracted with ease.

* Cases are from the Committee on Maternal Welfare of the Medical Society of the County of Kings, Brooklyn, N. Y. The text of the case reports is essentially as submitted to the Committee. The views expressed are those of the authors.

The placenta was extruded one minute later; blood loss was slight. At the end of the third stage the patient's condition was good, and the pulse was regular and of good quality. During repair of the episiotomy the anesthetist reported that the patient's blood pressure had fallen to zero. Blood which had been cross-matched was immediately administered. Respiration flagged and the patient died within twenty minutes. At autopsy the uterus was found to be ruptured.

CASE II. A thirty-six year old gravida VI, para V, with mild diabetes was admitted to the hospital in active labor. Previous pregnancies and deliveries had been uneventful except that all her babies were quite large, the last one weighing 11 pounds.

After twelve hours of active labor the cervix was 8 cm. dilated and the vertex at −3 station in the R. O. P. position. The membranes were then artificially ruptured but several hours later, despite good contractions, no progress had been made. In fact, cervical dilatation seemed less, due to increasing cervical edema. Morphine relieved pain yet regular and strong contractions continued. Since no progress had been made, the patient was taken to the delivery room where the cervix was found edematous and thick although dilatable, and the vertex at −1 station. Following several unsuccessful attempts at application of forceps, difficult version and extraction were performed. The operation took about one hour and resulted in the delivery of a stillborn fetus weighing 13 pounds, 4 ounces. Manual removal of the placenta was then performed because of profuse hemorrhage. The patient's condition on returning from the delivery room was fair, her blood pressure 100/60 and her pulse 96.

The following morning her condition was good except for a very tender abdomen attributed to the trauma associated with delivery. Later that day abdominal distention, nausea and vomiting appeared. The next day her temperature began to rise. Vomiting, distention and fever continued until death on the fourth postpartum day. At autopsy generalized peritonitis secondary to a rent low in the posterolateral wall of the uterus was found.

Questions. (1) What are the indications for version and extraction? (2) Is version indicated in routine management of the second of twins? (3) How are cases of failed forceps best managed? (4) What is the best anesthetic for version?

Answers. Version, hallowed by time, has been all but discarded as an accepted obstetric procedure largely because it is always a potentially hazardous operation for which safer procedures may now easily be substituted. The discovery and use of the antibiotics permit obstetricians to perform cesarean section on many patients for whom, in years past, version and extraction would have been elected. It has been said that a timely version will often ease the obstetrician out of many a difficult situation, but not, however, without the risk of creating a new problem for the mother and perhaps for the baby too.

What then are the indications for version? Few indeed. Prolapse of the cord when the cervix is fully dilated or nearly so, and the head beyond the safe reach of forceps, in the multipara is an accepted indication in the interest of the baby. In the primipara, however, if the presenting part is too high to risk forceps extraction, the patient should be placed in the Trendelenburg position and given oxygen while awaiting cesarean section. If fetal distress is clear, one may be assured that the deep general anesthesia necessary for version and extraction through a nulliparous birth canal will probably result in fetal death and frequently severe or fatal maternal injury as well.

The only other obstetric emergencies in which version may be indicated are transverse presentation in the multipara with the cervix fully dilated or nearly so, and the membranes intact or recently ruptured, and transverse presentation or distress of the second of twins. Transverse presentation in the primipara is best treated by cesarean section.

Routine version and extraction for delivery of the second twin increase maternal and fetal risk and are definitely contraindicated. We see no indication for this procedure other than the obstetrician's convenience. Uterine atony and postpartum hemorrhage are encountered frequently following multiple births because of overdistention of uterine muscle. If the obstetrician should choose to add the hazard of the deep anesthesia so necessary for version to rapid delivery by extraction, he must be prepared to accept the risk of excessive blood loss. A recommended routine for management of twin births is outlined which will eliminate the undesirable prolonged waiting period between the delivery of the first and second

babies, and also bring about a desirable high incidence of spontaneous birth of babies which often tend to be premature or small.

As soon as the first baby has been delivered, a vaginal examination is performed, the second amniotic sac ruptured and the presenting part identified. It is assumed that general anesthesia has been minimal. If the presentation is normal, a continuous drip of pitocin solution 1:500 is given through the venoclysis which should be functioning routinely at all multiple births. The rate of flow should be 30 drops per minute. Within a few minutes, even in those cases in which more than minimal general anesthesia (which is not advised) has been administered for delivery of the first baby, uterine contractions will be resumed and spontaneous delivery occur. Three minims of pitocin are then injected into the intravenous tubing and the drip continued. Uterine contraction is prompt and vigorous, bleeding minimal and the placenta will be extruded with little difficulty. The use of this simple technic will bring about marked reduction in the incidence of operative delivery and its partner, postpartum hemorrhage.

There is no place today for version in the management of persistent occiput posterior position, cephalopelvic disproportion, uterine inertia, failed forceps, abruptio placenta or placenta previa. Brow and posterior face positions in the multipara when the pelvis is normal and the baby of average size may be indications in the hands of the adept. At one time, to perform cesarean section late in labor was to court disaster from generalized peritonitis and sepsis, so that version would be resorted to as the lesser of two evils. Present day use of powerful antibiotics, availability of blood, and improved anesthetic and operative technics permit the performance of cesarean section with minimal risk.

The management of failed forceps should present no serious problem to the obstetrician. If forceps should fail, an error has been made in either judgment or technic, often both. Version is never a justifiable solution of the problem of failed forceps even though results should be good in some cases. Both fetal and maternal risks forbid its use. The defeated obstetrician who attempted delivery by version after he has failed with forceps admits frustration.

What then is the course to be followed when forceps delivery fails? *No immediate attempt at delivery should be made.* Anesthesia, if general, should be discontinued and an infusion begun while cross-matched blood is made available and antibiotics are administered. Dextran is suggested. It is as good as plasma and safer. The intravenous as well as the intramuscular routes may be advisable for antibiotics in order to obtain immediate high levels. An opinion must then be formed as to the reason for failure of forceps.

Usually failure is due to an unsuspected contracted pelvis, a large fetus or non-engagement of the vertex, unrecognized because of excessive moulding or caput formation. Occasionally a monstrosity or an unrecognized occiput posterior will cause forceps to slip. At this point roentgen pelvimetry would be highly desirable. If the pelvis should be ample and the fetus not abnormal, a further test of labor will often result in uncomplicated delivery. The alternative, of course, is some type of cesarean section supplemented by blood transfusion and vigorous antibiotic therapy with avoidance of general anesthesia. If episiotomy preceded or laceration resulted from the unsuccessful forceps attempts, repair should be carried out before deciding on the subsequent course of action.

Ether should always be the anesthetic agent when version or breech extraction is contemplated. The patient must be in the deep surgical stage of anesthesia before any attempt is made at turning the baby. Conduction anesthesia is definitely contraindicated. Chloroform, otherwise ideal, is dangerous. A common mistake of many anesthetists is to indicate that the patient is ready for version before relaxation is complete. If uterine contraction occurs or spasticity is present when the operator's hand is introduced into the uterus, deeper anesthesia and relaxation must be awaited.

Rupture of the uterus, hemorrhage and shock following laceration of the uterus, or atony secondary to deep anesthesia are the chief causes of maternal death. Not less than 1,000 cc. of cross-matched blood should be available and venoclysis must be functioning through at least an 18 gauge needle before delivery is attempted. Intravenous pitocin should be given immediately after delivery of the baby and manual exploration of the uterus is a *sine qua non*. The fetal risks are even greater than maternal. Intracranial hemorrhage, asphyxia, brachial plexus injuries, adrenal and liver hemorrhage and fractures

are not uncommon. It is difficult to conceive of any fetus, if it were in its power to choose, electing version and extraction for its delivery.

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CASE III. A young primipara was admitted to the hospital at term with ruptured membranes. On abdominal examination the presenting part was unengaged and the position was diagnosed as left sacral posterior. Twelve hours later the patient was having mild uterine contractions. Vaginal examination then found the cervix but 1 cm. dilated and somewhat thick with an irregular presenting part which was thought to be a foot. During the next twelve hours uterine contractions became more regular. The cervix was then found to be about 8 cm. dilated with what was diagnosed as a knee presenting. Six hours later cervical dilatation was complete; and as no further progress was made in descent of the presenting part, delivery was decided upon.

Under deep anesthesia the presenting part, which was now correctly identified as an elbow, was pushed upward out of the pelvis and both feet were grasped and brought down. Version was difficult, as was the extraction. The baby weighed 7 pounds, 3 ounces, and died one-half hour after delivery. The placenta was removed manually and the uterus then explored. Bleeding became profuse and the uterus remained atonic despite massage and repeated doses of oxytocics. Another exploration of the uterine cavity found no rupture. Preparations for transfusion were immediately made and the uterus was tightly packed. The patient was now in deep shock and died fifteen minutes later while the first transfusion was being given.

At autopsy the uterus was found soft, atonic and filled with blood-soaked packing. The cause of death was shock secondary to prolonged labor, difficult delivery, deep anesthesia and hemorrhage.

Questions. (1) How is transverse presentation best managed? (2) When should the uterus be explored following version? (3) Is manual removal of the placenta indicated at the time of uterine exploration? (4) How might this death have been prevented?

Answers. The management of transverse presentation has been considerably simplified in recent years due to wider employment of cesarean section. *Primiparas with transverse presentation should always be delivered abdominally.* Even though the cervix is fully dilated at the time transverse presentation is first recognized, delivery should be by cesarean section. Whether the membranes are ruptured or intact has no bearing on management. The fetal mortality associated with vaginal delivery in the primipara, aside from maternal complications, prohibits its use.

In the multipara some patients may be managed by version followed by spontaneous delivery or by version and extraction. The management of transverse presentation in the multipara will depend almost entirely on the status of the membranes and the cervix. A policy of watchful expectancy may be followed as long as the membranes remain intact. When full dilatation has occurred, delivery may be accomplished by version and extraction. If the membranes rupture prior to full dilatation, an immediate vaginal examination is made to rule out the possibility of a prolapsed cord, so common with this presentation, and also to determine the ripeness and degree of dilatation of the cervix. If the cervix is dilated sufficiently to admit a hand, version is performed, anesthesia discontinued and delivery awaited unless a new maternal or fetal indication should arise. When cervical dilatation is not sufficient to admit a hand yet the cervix is quite ripe, one may observe the progress of labor for a short while, certainly not more than an hour or two, hoping for sufficient dilatation to permit version. If this should not occur, cesarean section should be performed. Dilating bags have no place in the treatment of transverse presentation.

The frequent association of placenta previa with transverse presentation should be kept in mind. It has been reported as high as 25 to 30 per cent.

Exploration of the uterus and vagina after version should be done immediately after delivery. It is not necessary to disturb the placenta. Rupture, if present, will be found involving the cervix or lower uterine segment, not at the placental site. Manual removal of the placenta in the absence of bleeding is dangerous. Uterine atony is the rule following the deep anesthesia necessary for version, and for this reason there should be no efforts at placental expression. Enough time should elapse for the uterus to regain its contractility. Intravenous administration of an oxytocic as soon as the baby has been delivered will be found helpful in counteracting atony.

There were many errors of judgment in the management of this patient. Delivery should have been by cesarean section even though diagnosis was late. Manual removal of the placenta should have been deferred until uterine tone had returned. Hemorrhage should have been anticipated and cross-matched blood should have been available before version was attempted. Then, too, this case illustrates the futility of uterine packing in the treatment of hemorrhage.

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CASE IV. A thirty-four year old primipara in the thirty-eighth week of pregnancy, while being admitted to the hospital for severe pre-eclampsia, experienced an eclamptic seizure and fell to the floor fracturing her right humerus at the surgical neck. Because of her critical condition the fracture was not discovered until several days later.

Following the convulsion the patient lapsed into coma. Her blood pressure was 230/130, the pulse rapid and regular, and rales were scattered over both lung fields. Proteinuria was reported as 4 plus and the uterus was palpated several fingers below the xyphoid process. There were no audible fetal heart tones. Weak irregular uterine contractions were present.

During the next twelve hours the patient had sixteen convulsions. Treatment consisted of morphine, digitalization, intramuscular magnesium sulfate and hypertonic intravenous glucose. During the next four days her condition gradually improved; the blood pressure dropped to 140/100, urinary output increased, edema disappeared and proteinuria diminished. Her temperature, which had fluctuated between 102° and 106°F. the first twenty-four hours, returned to normal on the second day, when it was first noted that the patient was losing amniotic fluid. However, uterine contractions had apparently stopped.

On the fifth day after her first eclamptic seizure labor became active, and six hours later a hand presented at the vulva. Consultation was obtained. On vaginal examination the cervix was found fully dilated and the presentation transverse with the shoulder impacted. A retraction ring was seen and no fetal heart sounds were audible. The patient's temperature had again risen to 103°F. Large doses of antibiotics were administered intravenously and intramuscularly, and the patient was taken to the operating room.

She was placed in low stirrups and the perineum and abdomen prepared surgically, following which the abdomen was draped for a laparotomy and the perineum draped for delivery. With the patient under deep ether anesthesia, one team of surgeons opened the abdomen through a low midline incision from symphysis to umbilicus. The obstetrician performed an episiotomy and introduced his right hand into the uterus after displacing the shoulder upward. Then, with his left hand inside the peritoneal cavity through the abdominal incision, a slow careful version was performed. Cross-matched blood was available in the operating room and a venoclysis was functioning. All preparations were at hand for immediate hysterectomy if it should become necessary.

Following completion of the version, extraction of a macerated stillborn fetus was accomplished with ease. Relaxation of the uterus after delivery of the placenta was controlled by direct massage and intravenous oxytocics. The abdomen was then closed. The patient's postoperative course was smooth with normal temperature from the second day on.

Question. How is neglected transverse presentation best managed?

Answer. This case, although the patient did not die, is presented because of a new approach to the problem of neglected transverse presentation. Textbooks offer several solutions for the management of this rare but serious complication. Decapitation by means of a sickle knife with extraction of the body by traction on the arm, followed by delivery of the decapitated head, is a procedure of considerable risk except perhaps in the most expert hands. Its use is limited of necessity to dead babies. Who, in modern day obstetrics, will ever have the opportunity to become expert in such a procedure?

Extraperitoneal cesarean section, although mentioned as a method of treatment, is not a good choice for technical reasons. If the incision is kept in the lower segment, as it of necessity must be if the operation is to remain extraperitoneal, the shoulder and arm will present in the incision with the laterally flexed head well above. One must then attempt to complete a version through an incision in the lower segment, which is difficult, dangerous and impractical, or of necessity extend the incision

high enough to deliver the head first. If the latter is done, the operation will no longer be extraperitoneal. Cesarean hysterectomy is reserved possibly for those women who have two or three living children.

The only satisfactory method of treatment remaining, then, is lower segment cesarean section through a longitudinal uterine incision so that adequate room will be available for delivery of the vertex. The patient must be protected against infection by adequate pre- and postoperative antibiotics.

If a lower segment operation or cesarean hysterectomy is elected as the procedure of choice, it seems to us both feasible and desirable to attempt version once the adbomen has been opened. If version is not possible, the originally planned operation may be performed. The risk of rupture of the uterus should be extremely small; and even if it did occur, prompt life-saving action would be possible. The advantages of this new type of version are obvious.

* * * *

Case v. A young primipara at term was admitted to the hospital with irregular uterine contractions. The membranes were intact and the cervix 2 fingers dilated; the vertex was unengaged. After twelve hours of labor the cervix was found to be fully dilated with the vertex at a +1 station in R.O.P. position. Under caudal anesthesia several unsuccessful attempts were made at forceps rotation. When forceps were removed, the umbilical cord was found prolapsed in the vagina. Caudal anesthesia was supplemented with ether and an attempt made at version which could not be completed because of the tight uterus. All anesthesia was then stopped and treatment instituted for the mild shock which had developed. An obstetric consultant saw the patient one hour later and advised conservative management. At this time the vertex and one hand were presenting at the inlet, and the patient was again beginning to have uterine contractions. Her condition was much improved following a transfusion of 1,000 cc. of blood. The cord was still present in the vagina but no pulsations could be felt. After five hours of fair contractions the vertex was found at the level of the spines. Craniotomy was decided upon as the patient's pulse rate was again rising and secondary uterine inertia had developed. Another 500 cc. transfusion of blood was begun and under gas-oxygen-ether sequence the vertex was perforated with a Smellie perforator, crushed and extracted with a cephalotribe. The placenta was removed manually and the uterus explored. Blood loss was considered minimal, yet the patient was in shock. Another transfusion of 1,000 cc. of blood was administered with but little improvement and the patient died two hours after delivery. At autopsy the cause of death was certified as shock and hemorrhage.

Case vi. This patient was a twenty-four year old primipara with pre-eclampsia who was admitted to the hospital for observation two weeks prior to term. Her blood pressure was 160/100 and urinalysis showed slight proteinuria. Induction of labor was decided upon after four days of observation as toxemia appeared to be unimproved. On vaginal examination the pelvis was considered ample, with the fetus in R.O.P. position at a −1 station and the cervix 1 finger dilated. The membranes were ruptured artificially and irregular uterine contractions began eight hours later. Labor progressed slowly, and after twenty-six hours the cervix was fully dilated with the vertex at the spines still in posterior occiput position. Two hours later, because of lack of progress, forceps delivery was attempted but was unsuccessful apparently because of a contraction ring. Ether anesthesia was discontinued and consultation was obtained. Anesthesia was then resumed and manual rotation was attempted. This, too, was unsuccessful. Since the fetal heart sounds had disappeared after the first attempt at delivery, the head was perforated and delivery effected with a craniocast. This procedure was difficult and prolonged, with the patient in shock at its conclusion. Exploration of the uterus showed no evidence of rupture. A blood transfusion was begun but pulmonary edema soon developed and death followed three hours later.

Questions. (1) What operative procedure might have been substituted for the foregoing type of craniotomy? (2) What is the risk of craniotomy? (3) How should prolapse of the cord be treated in the primipara? (4) Is craniotomy on a live baby ever indicated?

Answers. Craniotomy as described would seem hardly defensible. Since 1940 modern obstetrics has entered a Renaissance period as the result of sulfonamides, antibiotics, avail-

ability of large amounts of blood, improved anesthetics and surgical technics, and wider use of the cesarean operation in treatment of complications. The period prior to 1940 might well be known as the Traumatic Era, when maternal and fetal mortality as well as morbidity were truly appalling. It was then that cranioclasts, cephalotribes and various other crushing and tearing instruments were used for delivering babies who might have been delivered otherwise if fear of puerperal sepsis were less. One would indeed be hard put to justify the performance of some of the types of embryotomy still described in standard textbooks. Most of these destructive instruments could well be removed from their sterile wrappings and deposited in obstetric museums.

One does not like to subject a woman to cesarean section when it is known that the baby is already dead. However, craniotomy when the vertex is unengaged or just engaged at mid-pelvis is often a prolonged and formidable procedure. Delivery of the head from these high stations, even when crushed, is very difficult and associated with extensive maternal laceration. Maternal mortality rates as high as 10 per cent have been reported. Prolonged anesthesia, hemorrhage and, not infrequently, shock are invited. Cesarean section might well have been a wiser choice, yet a much simpler procedure will usually suffice. Simple perforation of the skull with a Smellie perforator is usually all that is necessary. General anesthesia is not required. In fact, if any anesthesia is necessary, local pudendal block will suffice. The scalp is grasped with clamps in the region of the small fontanel preferably, incised and the perforator inserted between the sutures, and the cranial contents broken up. The clamps are then placed upon the edges of the cranial bones and a 1 or 2 pound weight tied to the clamp handles with a bandage, and the patient allowed to continue in labor. Traction keeps the vertex flexed, stimulates labor and assists in descent. Adequate supportive therapy is given; fluids for acidosis, blood to prevent shock and antibiotics to combat infection. Spontaneous delivery will be the rule rather than the exception.

Craniotomy on the living fetus is no longer an accepted obstetric procedure. Always questionable today, there can be no valid indication for its performance. Even cephalopelvic disproportion secondary to hydrocephalus is easily managed by awaiting sufficient cervical dilatation to permit its decompression. This is easily accomplished vaginally by inserting a long, large-bore needle through a fontanel or open suture and aspirating the excess fluid. This is but the obstetric application of an accepted pediatric procedure for the management of hydrocephalus after birth.

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CASE VII. A twenty-five year old primipara whose prenatal course had been normal was admitted to the hospital at term in active labor. After six hours of labor she was delivered of an 8 pound, 1 ounce baby spontaneously. The placental stage was slow so repeated attempts at manual expression were made. Delivery of the placenta was finally accomplished by vigorous fundal pressure. Inversion of the uterus was immediately diagnosed by the intern in attendance, who attempted to reposit the uterus and then packed the vagina tightly. No anesthesia was necessary as the patient was in profound shock. Intravenous glucose and plasma were administered. When the patient was seen by an attending physician an hour later, her condition was still critical although thought to be somewhat improved. The packing was not disturbed. Examination of the abdomen showed nothing of note other than the firmly contracted uterus just to the left of the midline. A 500 cc. transfusion of blood was administered one hour later when shock became even more profound. The patient died three hours postpartum. At autopsy the firm mass felt in the lower abdomen was found to be the inverted uterus which had been pushed upward by the tight vaginal packing.

CASE VIII. After five hours of labor a young primipara was delivered by low forceps under general anesthesia. Following several unsuccessful attempts at Credé expression, the placenta finally appeared at the vaginal introitus as the result of abdominal pressure and gentle traction on the cord.

The uterus was inverted with the placenta still attached. The patient, in mild shock, was treated with a glucose infusion while blood was being cross-matched.

When obstetric consultation was obtained about a half hour later, the patient's condition had somewhat improved. She was anesthetized again and the consultant removed the placenta manually. During and after this procedure hemorrhage was profuse and shock recurred.

With some difficulty the inversion was corrected and the uterus and the vagina were packed. A 500 cc. transfusion of blood was given rapidly and the patient improved, the blood pressure rising to 90/60. While a second transfusion was begun, the patient began to bleed through the vaginal packing. Shock once more became profound and death occurred about three hours later.

Questions. (1) Is the diagnosis of inversion of the uterus difficult? (2) How is it produced? (3) What is the best treatment? (4) How should the placenta be managed if still attached?

Answers. It is indeed a shocking experience for both patient and obstetrician when this rare complication occurs. Its incidence has diminished in recent years as a result of better management of the third stage of labor. Chronic inversion of the uterus will not be discussed as we are considering only complications of the immediate postpartum period.

Inversion of the uterus is either complete or incomplete. Diagnosis of the complete type is easy. The uterus turned inside out will be seen at the vaginal introitus. In incomplete inversion the fundus remains in the upper vagina and diagnosis may not be obvious. Abdominal palpation may be of little value, especially if the patient should be obese or heavily muscled. Shock and hemorrhage are the characteristic symptoms. A diagnosis of rupture of the uterus will be suspected if shock is out of proportion to the blood loss. Uterine exploration will then readily make the diagnosis of inversion of the uterus. Surely all by now will agree that this type of examination should be routine in any case of obstetric shock or postpartum hemorrhage.

Despite the rarity of this complication, a rather extensive literature is concerned chiefly with two controversial points: first, whether inversion is the result of trauma; and secondly, whether management should be primary shock therapy or immediate correction of the inversion.

The etiology of inversion is not fully understood, yet certain predisposing factors are clear. That spontaneous inversion has occurred cannot be denied, yet there is little doubt that in the great majority of cases, as in the two reported here, trauma plays a definite role. Trauma alone is not sufficient to cause inversion else its incidence would be much higher. Traction on the cord of itself will not cause it. The cord will tear and undoubtedly it has ruptured many times before inversion could occur. Similarly, pressure on the fundus heavy enough to cause ecchymosis of the patient's lower abdominal wall will not invert the uterus. In fact, inversion of the uterus cannot be produced by either or both of these procedures unless other conditions are present. Fundal insertion of the placenta appears to be present in all cases; yet since this is said to occur in the neighborhood of 30 per cent of all deliveries, another predisposing factor must be assumed. Uterine atony must be present, and at that an unusual type of atony including only the fundal placental site, for once relaxation and dimpling occur in this area contraction of the lower uterine areas must occur to result in inversion. Especially must this be so when inversion has occurred after extrusion of the placenta. It is this later unusual type of atony which accounts for the fact that inversion is rare. Even though the placental site should be atonic, if management of the third stage is proper inversion can almost certainly be avoided. It is likely that there must be a thinning of the fundal musculature of the uterus. This may be on a congenital basis secondary to minimal defect in proximal Müllerian duct fusion not sufficient to produce bicornuate changes. This would explain the occasional tendency for reappearance of inversion in a subsequent pregnancy as well as its prompt recurrence after replacement. Veterinarians have long reported the not uncommon incidence of inversion of the uterus in animals.

The best treatment of inversion of the uterus is immediate replacement. The sooner the attempt is made at replacement, the more successful it is likely to be. Firm contraction of the lower segment will not have occurred and general anesthesia will not be necessary. The technic of replacement is simple yet must be carefully carried out to be successful in most cases. With the whole hand in the vagina, the globular inverted fundus is grasped with the fingers posterior and the thumb anterior, and gently squeezed. Slow, steady pressure is then made upward in the curve of Carus. *Two points in the procedure are of importance.* The first is to remember not to press backward to the spines or sacrum, but upward into the abdominal cavity in a line perpendicular to the superior pelvic strait. The second is to maintain the pressure steadily. This will pull on the

uterine ligaments and so help to correct the inversion. If difficulty is encountered, several sponge sticks or ring clamps may be placed on the cervical rim and countertraction made downward as the fundus is gently pushed upward. When the uterus has been reposited an intravenous oxytocic should be given and uterine massage performed between the internal and external hands. When uterine tone has returned, the hand may be removed from the uterus. Uterine packing will not be necessary. The uterus should be carefully observed through the abdominal wall for one hour after replacement.

Many of these patients will go into shock immediately following inversion. There seems little doubt that shock is neurogenic in origin due to traction and pressure resulting from constriction of the rich ovarian and uterine plexuses of nerves beneath the peritoneum, just as a severe blow to the solar plexus may produce shock. In the case of inversion, however, shock is apt to be more prolonged and severe as the nerve plexus trauma is continuous rather than the result of a single blow.

Immediate shock therapy is indicated. Intravenous neo-synephrine 1:500 solution is given, and blood should be made ready for transfusion if indicated. Postpartum hemorrhage is common with this condition and is the cause of death. Blood loss indeed may be minimal yet sufficient to aggravate the already existing neurogenic shock. As is true of postpartum hemorrhage due to other causes, there will be ample time to treat these patients. Death does not immediately follow inversion but usually occurs three to four hours later.

If the patient is first seen hours after the inversion has occurred and shock is profound, adequate shock therapy should be begun before any attempt is made to reposit the uterus. Blood is essential in these cases as almost invariably there has been associated blood loss.

If the placenta is still attached, as it will be in the majority of cases, an attempt should be made to replace the uterus with the placenta still attached. Although more difficult, this will be possible if inversion has just occurred. After the uterus has been reposited, manual removal of the placenta should not be attempted until an intravenous oxytocic has been administered and uterine tone has returned. When the placenta has been separated, it should be delivered by traction on the cord, leaving the hand in the uterus for bimanual massage.

If it is necessary to remove the placenta in order to reposit the uterus as in Case VIII, this should be delayed but only long enough to have adequate blood replacement available.

The best prophylaxis of all is the use of the slow delivery technic and administration of an intravenous oxytocic with the anterior shoulder.

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CASE IX. A twenty-eight year old primipara was admitted to the hospital at term. The vertex was in L. O. P. position at −2 station, the cervix about 3 cm. dilated and the membranes were intact. Several hours later labor began but contractions were irregular and of poor quality. The roentgenologist reported an android pelvis and no cephalopelvic disproportion. After twenty-four hours of irregular contractions the membranes ruptured and the vertex descended to the level of the ischial spines; the cervix was now dilated 4 cm. After another twelve hours of painful and somewhat irregular contractions the vertex was found at +1 station and the cervix 7 cm. dilated. Since the patient appeared to be exhausted and the amniotic fluid was meconium stained, delivery was decided upon.

During induction of general anesthesia the patient vomited and excessive mucus in the pharynx and larynx was troublesome. Contraction of the bony pelvis was not apparent and the vertex was found at +1 station in the L. O. P. position. The cervix, which was 6 cm. dilated and effaced, was grasped with sponge forceps and Dührssen's incisions were made at locations corresponding to 10, 2 and 6 on the clock. The vertex was then manually rotated to the L. O. A. position and mid-forceps were applied. Delivery of a 5 pound, 6 ounce stillborn fetus was accomplished with moderate traction. During repair of the cervical incisions, vaginal bleeding became profuse but manual removal of the placenta controlled bleeding. No extension of the cervical incisions was found. The patient was in shock, her blood pressure 80/50 and her pulse rate 140. Blood transfusion was administered by positive pressure. While awaiting more blood the cervical incisions and the episiotomy were repaired. During recovery from anesthesia the patient again vomited large amounts. Moderate vaginal bleeding recurred but was controlled by uterine massage.

The patient was again found to be in shock, and pulmonary edema was marked. Death occurred within the hour.

CASE X. A twenty-nine year old primigravida at term, short of stature and weighing 210 pounds, entered the hospital because of ruptured membranes. Her antepartum course had been normal. X-ray pelvimetry revealed no evidence of cephalopelvic disproportion. Contractions were irregular and slight. The cervix was not dilated and the presenting part was unengaged. The following day uterine contractions were still irregular and the vaginal findings were unchanged. Fifty hours after admission the contractions became stronger and the vertex descended to a +1 station and the cervix dilated to 5 cm. After six hours of good labor when the contractions again became irregular, glucose solution, morphine and scopolamine were administered. The following morning the patient was exhausted, uterine inertia was still present, the cervix 7 cm. dilated and the vertex at the spines in the L. O. T. position. Under general anesthesia Barton's forceps were applied, but no descent occurred with moderate traction so they were removed. Cesarean section seemed indicated. However, an associate who was called in consultation found a contraction ring which he thought accounted for the dystocia and believed the patient should be delivered from below. One cubic centimeter of adrenalin was administered, anesthesia deepened and Kielland's forceps were applied. Dührssen's incisions were made laterally in the cervix and after considerable difficulty an 8 pound, 10 ounce stillborn fetus was delivered. Uterovaginal exploration revealed marked lacerations of the vagina but no extension of the cervical incisions. The placenta was expressed intact. During repair of the lacerations and incisions the patient went into shock. Blood loss was estimated at about 600 cc. Blood transfusion was begun but the patient died before it was completed. Postmortem exploration of the uterus revealed no evidence of rupture.

Questions. (1) When are Dührssen's incisions indicated? (2) How might they have been avoided in these cases? (3) What is cervical dystocia? (4) Is the diagnosis of contraction ring difficult? (5) What is its treatment when diagnosed? (6) What are the complications resulting from Dührssen's incisions?

Answers. Dührssen's incisions, although a time-tested and obstetrically sound procedure, are now seldom resorted to as a solution of prolonged labor. Better management of uterine inertia and prevention of intrapartum infection have resulted in a marked decrease in the accepted indications for cervical incisions.

Cervical effacement must be complete, the vertex engaged and dilatation should be at least 6 cm. before delivery by this method may be considered. Fetal distress is rarely a valid indication. Cervical incisions and mid-forceps delivery will more likely than not add to fetal embarrassment. *It cannot be too strongly emphasized that meconium-stained fluid and changes in fetal heart rates from 100 to 180 may be present and yet there still may be no evidence of fetal distress at delivery.* Small babies which present as a footling breech will occasionally deliver through an incompletely dilated cervix as far as the head, which having the largest diameter cannot pass through the rigid cervix. Dührssen's incisions, although more difficult to perform, may be lifesaving for this baby.

Arrested labor in the primipara, with the vertex at or below the spines with the cervix effaced but not fully dilated, is still the most common indication for Dührssen's incisions. Almost without exception there has been early rupture of the membranes and labor has been complicated by uterine inertia.

Proper management of the first stage of labor in both of the foregoing cases might well have resulted in a happier outcome. The prolongation of labor with failure of complete cervical dilatation was the result of uterine inertia. The cervix did not dilate because the uterus did not contract in a manner which would produce complete retraction and dilatation. In normal labor the intensity of the uterine contractions increases from below upward to the fundus. They are regular in type and result in progressive cervical dilatation. With uterine inertia the contraction of the lower part of the uterus may equal or exceed the fundal contraction. These contractions are often irregular, very painful, and the cervical dilatation which results is very slow and incomplete. Although these cases are often diagnosed as cervical dystocia, the cervical findings are the result, not the cause, of the dystocia. A much better term is dysfunc-

tional labor. Cervical dystocia will not result from previous cauterization, lacerations, Dührssen's incisions or abnormal amounts of muscle or fibrous tissue. Previous partial amputation of the cervix with excessive scar tissue formation alone may produce cervical dystocia.

How then should the primipara who has ruptured membranes, an unengaged vertex and irregular contractions be managed? First and most important is vaginal examination (1) to discover if the membranes are ruptured, as the history is often unreliable, (2) to estimate the ripeness and dilatation of the cervix and (3) to make a clinical appraisal of the pelvis by palpation. X-ray examination, although not essential, may be helpful in diagnosis of an occasional brow presentation and in the determination of the type and measurements of the pelvis. If the cervix is not ripe and there is no evidence of cephalopelvic disproportion, antibiotics should be administered and the onset of labor awaited. Pituitrin stimulation is contraindicated in the presence of an unripe cervix. If contractions occur, a sedative should be given with the expectation that the contractions are due to false labor. If the cervix is found to be ripe and contractions continue to be irregular, intravenous pituitrin drip 1:500 at the rate of 30 drops per minute should be begun. The necessity for careful observation has been sufficiently stressed. In cases of true uterine inertia it may be necessary to continue the pituitrin throughout the first and second stages of labor. Needless to say fluid balance should be maintained and acidosis controlled so far as possible. One hundred cubic centimeters of blood are cross-matched in anticipation of third stage inertia and general anesthesia is avoided. With this management of uterine inertia, the need for cervical incisions will rarely arise. If labor does not progress satisfactorily, cesarean section may be performed at a time when the patient is still a good operative risk.

It is interesting to note the different methods elected for delivery following incision of the cervix—manual rotation and classical forceps application in the first case, and Barton's and Kielland's forceps in the second. There is no unanimity of opinion as to the procedure of choice. Excellent obstetricians have and will continue to favor different technics with seemingly equally good results. That their results might be better with occasional variations in technic is conjectural but certainly possible.

Analytic statistical surveys do not help us to determine the procedure of choice. Many intangible factors play a part, namely, the dexterity of the individual operator, structural variations of the pelvis, size and malleability of the fetal head and even accurate estimations of the stations of the head. Experience has taught us that the great majority of persistent posterior and transverse arrests may be successfully delivered by any one of several different procedures if the operator is able to carry it out properly. No method will be easy or safe if even borderline cephalopelvic disproportion exists; nor is mid-forceps ever easy with the vertex at, or just below, the spines. Cesarean section is often a wiser choice. Greatest difficulty is likely to be encountered when the sacrum is flattened and/or the promontory of the sacrum juts forward. Persistence in the use of Kielland's forceps in this type of pelvis will result in extensive vaginal laceration as in the last case. Manual rotation, too, is made difficult by a prominent promontory of the sacrum. Traction downward with rotation at a lower plane may be the only feasible method for delivery. The fetal risk increases with this method of delivery.

Contraction ring is usually neither suspected nor diagnosed until attempts at delivery fail, as in Case x. Rarely in cases of neglected labor, the diagnosis may be made by inspection of the abdominal wall. That contraction ring is present more often than we suspect seems likely, especially when membranes have been ruptured for some time and delivery is difficult.

Treatment of this formidable complication of labor is unsatisfactory. Sedation will have no direct effect upon the ring although it may give the mother a much needed rest. Adrenalin has been worthless in our hands and is dangerous in 1 cc. doses. Deep general anesthesia may be necessary despite the dangers of fetal anoxia and postpartum hemorrhage. Cesarean section is the lesser of two evils.

The complications which result from Dührssen's incisions are relatively few. Extension may occur but is not likely. Bleeding from the incisions is uncommon; and if proper assistance and retraction has been provided for, suturing of the incisions is not difficult. Laceration of the uterine artery, although often mentioned as most to be feared, should not occur if

cervical effacement has been complete. The difficulties associated with Dührssen's incisions are secondary to the complications which necessitated the operative interference. These are hemorrhage, shock, and to a much lesser degree, infection. Uterine inertia prior to delivery begets uterine relaxation and hemorrhage during the third stage of labor. This must always be anticipated and provided for. Clinical experience has shown that long labor conditions the patient for shock. The fatigued and fearful patient withstands trauma and blood loss poorly. Antibiotics are indicated in the early postpartum period as well as during labor as intrauterine infection is often present even though maternal temperature is normal.

Announcement: The entire series of fourteen Obstetric Clinics will be available in a complete reprint which can be obtained from the publisher.

Case Reports

VOLVULUS OF CECUM DUE TO LITHOPEDION*

BERT A. GLASS, M.D. AND PAUL D. ABRAMSON, M.D.
Shreveport, Louisiana

THE finding of a lithopedion is rare, as evidenced by reference to the literature. In 1941 Reeves and Lipman[1] reported a total of 236 cases in a review of almost five centuries of the literature. In 1947 Brandman[2] found an additional ten cases and reported one case of his own, bringing the total to 247 cases. In 1951 Anderson, Counseller and Woolner[3] reported on two additional cases from the literature and added three cases of their own, bringing the total to 252 cases.

An incidence of 2 per cent lithopedions occurring in extrauterine pregnancies was reported by Masson and Simon.[4] Anderson, Counsellor and Woolner[3] reported an occurrence of 0.81 per cent lithopedions in 370 cases of extrauterine pregnancies. Brandman,[2] from his review of the literature, believed that an incidence of 1.5 to 1.8 per cent was an acceptable figure.

Volvulus of the cecum is likewise a rare finding. Donhauser and Atwell[5] in a thorough review of the literature in 1949 credit Rokitansky with the first description of the disease in 1841 and state that since then from 300 to 400 cases have been reported. Most of these have been reported from Central European countries and Russia where the incidence is greater than in the United States or England. The reported incidence of intestinal obstruction due to cecal volvulus varies from 5 to 11 per cent in the European countries. In the United States Rothman[6] reports an incidence of 0.67 per cent, Sweet[7] 1.15 per cent and Donhauser[5] 4.3 per cent.

The case reported herein represents the occurrence of intestinal obstruction and perforation of the cecum due to volvulus of the cecum with the twisted portion of the volvulus originating from an adherence of a mobile ascending colon to a retrocolic lithopedion. It is our belief that in this case the volvulus was definitely related to the presence of the lithopedion lying in the right colic gutter behind the ascending colon. An incidental finding in this case was atresia of the right main stem bronchus with either total atelectasis or congenital absence of the right lung and marked mediastinal shift to the right.

CASE REPORT

E. P. (Hosp. No. 52-4948), a forty-eight year old Negress, was admitted to the surgery service of Shreveport Charity Hospital on September 18, 1952, complaining of generalized cramping abdominal pain which began six days prior to admission after ingestion of tuna fish and watermelon. This was followed shortly thereafter by nausea and vomiting of all food or liquids taken by mouth. The patient had had a normal bowel movement prior to onset of illness, but no bowel movements since onset in spite of laxatives and enemas. The pain had become more severe since onset, gradually changing from an intermittent cramping type to a steady, generalized abdominal pain. Twenty-four hours prior to admission her abdomen had become markedly distended and she had become somewhat dyspneic.

Past history revealed weight loss of around 20 to 30 pounds over the past six months. She also gave history of some palpitation of heart and slight exertional dyspnea for the past several months, with occasional left chest pain over the past few weeks. The menopause had occurred approximately three years prior to admission and no history of abnormal bleeding or abdominal pain occurring around that time could be elicited from the patient.

* From the Department of Surgery, Shreveport Charity Hospital, Shreveport, La.

FIG. 1. Flat plate roentgenogram of abdomen showing lithopedion lying in right lower quadrant of abdomen, with multiple dilated loops of small and large intestine visible.

FIG. 2. Upright roentgenogram of abdomen showing fluid levels in small and large intestine. Lithopedion visible in right lower quadrant.

Physical examination revealed a markedly emaciated, somewhat irrational, dehydrated, anemic, Negro women, with marked abdominal distention and apparently in severe abdominal distress. Marked pallor and dryness of all mucous membranes and extremely poor skin turgor were present. Pulse rate was 140 per minute; temperature, 99.2°F.; respirations, 22; blood pressure, 120/88. Examination of the chest revealed marked shift of the mediastinum to the right, with the apex beat visible in the fourth interspace at the mid-clavicular line on the right side of the chest. There was dullness to percussion over the entire right chest, with absent breath sounds on the right. There were a few crepitant rales over the left lung base and the left lung field was hyperresonant. As mentioned previously the heart was shifted far to the right with the apex beat visible and palpable in the right fourth intercostal space. The pulse was 140 per minute, the rhythm regular, the heart sounds of good quality and intensity and there was a soft blowing systolic murmur at the apex. On close questioning neither the patient nor her family could throw any light on just how long the apex beat had been on the right side of the chest. Some members of the family thought the phenomenon had existed only a few days, others thought for years and others thought since birth. The patient absolutely refused to hazard even a guess as to duration. Neither the patient nor her family were considered reliable informants.

Examination of the abdomen revealed generalized distention, tympany, tenderness and questionable rebound tenderness without localization. No masses were palpable and no fluid wave or shifting flatness could be elicited. Bowel sounds were hypoactive and distant with a metallic sound but no peristaltic rushes. Pelvic examination revealed the cervix to point posteriorly, with no gross lesions palpable or

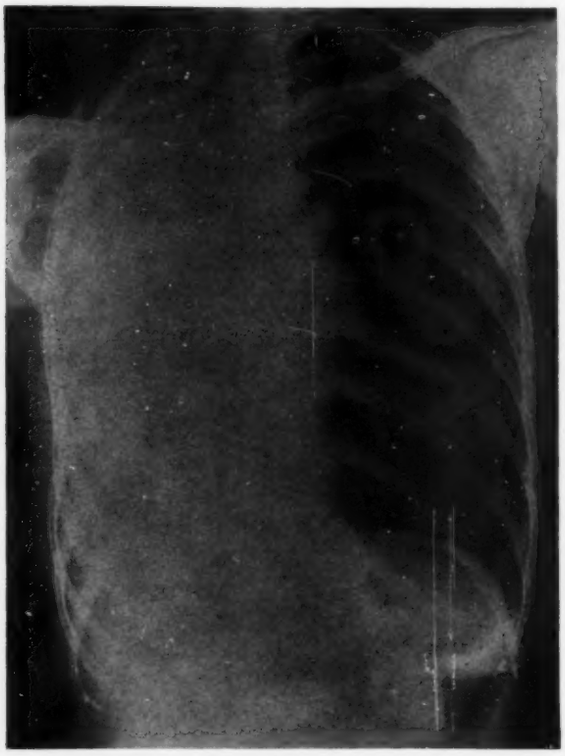

FIG. 3. Roentgenogram of chest showing homogenous density of right chest suggestive of fluid.

visible. Bimanual examination of the pelvis was unsatisfactory due to abdominal distention and extremely poor cooperation on the part of the patient. The rectum was collapsed and empty. A sigmoidoscope was passed 25 cm. with no obstruction or feces encountered.

Laboratory tests revealed a hemoglobin of 11.0 gm. per cent, white blood count 5,050 with 50 per cent segmented neutrophils, 14 per cent neutrophil stabs and 36 per cent lymphocytes. Urinalysis was negative except for 3 to 4 white blood cells per high power field. Flat plate roentgenogram of the abdomen (Fig. 1) showed multiple dilated loops of small intestine, chiefly in the epigastrium, and one large loop of greatly dilated large bowel in the lower abdomen. Upright film (Fig. 2) showed multiple fluid levels in the small bowel. At the level of the 5th lumbar vertebra overlying the wing of the right ilium a calcified mass with the appearance of a mummified fetus of approximately four to five months' gestation was noted. EPA of the chest (Fig. 3) showed the entire right lung field to be obliterated by a homogenous density suggestive of fluid. There was also a marked shift of the mediastinum to the right and only the shadow of the descending aorta could be identified. Subsequent films appeared to show massive atelectasis without definite evidence of fluid on the right side.

The patient was treated with Miller-Abbott tube suction, intravenous fluids, electrolytes, whole blood and antibiotics. After approximately twelve hours of conservative treatment distention had decreased slightly and the patient felt better. However within another twenty-four hours she again became distended, pain increased and there was definite generalized rebound tenderness. Her general state of hydration and electrolyte balance was such at that time that she was thought capable of withstanding exploratory laparotomy.

On October 20, 1952, she was explored under spinal anesthesia through a right lower paramedian incision. The cecum was found to be tremendously dilated with a lesser amount of small intestinal distention. There were two areas of gangrene of the cecum. One such area measured 2 to 3 cm. in diameter and had apparently perforated and then had been closed off by adhesion of the greater omentum to the perforation. The other gangrenous area of impending rupture of the cecum measured approximately 1 cm. in diameter. There was a calcified mass approximately 10 by 8 cm. in size palpated lying behind the ascending colon in the right colic gutter approximately 3 to 4 inches distal to the ileocecal valve. At this point the ascending colon was firmly attached to the retrocolic mass and the cecum had twisted in a counterclockwise direction approximately 180 degrees, thus creating a closed loop obstruction which had later developed into a concomitant small bowel obstruction. The ascending colon distal to the point of volvulus, the transverse colon and the descending colon were collapsed. (Fig. 4.) There were approximately 50 to 100 cc. of purulent, fecal-smelling liquid free in the peritoneal cavity.

The adhesive omentum was carefully detached from the cecum and the volvulus gently reduced. The lateral peritoneal reflection from the ascending colon was incised sufficiently to allow mobilization and exteriorization of the entire cecum including the necrotic areas. The calcified mass could then be visualized lying in the right colic gutter and bound down firmly posteriorly. Due to the patient's poor condition no attempt was made to dissect the mass free. The cecum was exteriorized through the lower end of the incision and the abdomen was closed

in layers. After closure of the abdomen a purse-string suture was placed in the cecum around the largest necrotic area, a stab wound made into the cecum and a mushroom catheter introduced into the cecum and then into the ileum. The patient ran a surprisingly benign post-

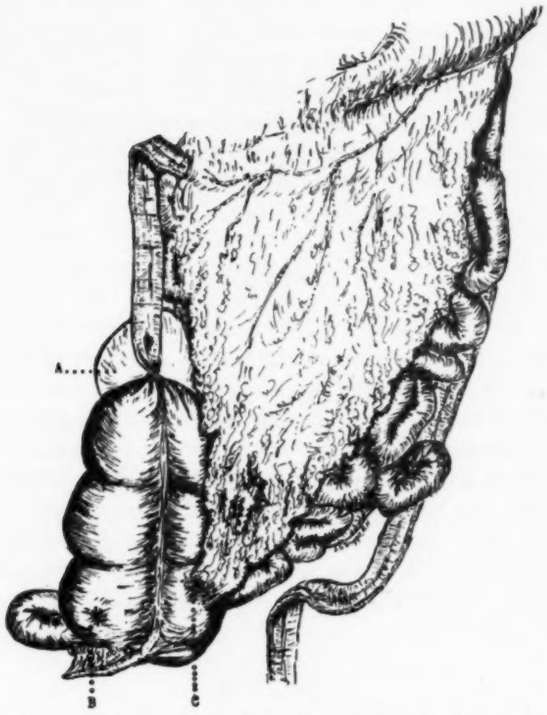

FIG. 4. Artist's conception of operative findings: (A) retrocolic lithopedion lying behind point of volvulus in ascending colon; (B) point of impending perforation of cecum due to gangrene; (C) point of gangrenous perforation of cecum sealed off by omentum.

operative course and on the fourth day the cecostomy tube and gastric tube were removed.

An attempt was made to improve the patient's general state of nutrition and an investigation of the pulmonary disorder was instituted. On bronchoscopy the patient was found to have a marked constriction of the right main stem bronchus at the bifurcation of the bronchus. Bronchograms were attempted and no lipiodol could be made to pass beyond the division of the right main stem bronchus. A retrograde pyelogram showed the right ureter to pass medially and posteriorly to the calcified mass.

On November 11, 1952, after thorough bowel preparation with antibiotics and enemas the patient was again taken to surgery, the cecostomy closed in layers and the abdomen explored. The calcified mass was found to be

FIG. 5. Photograph of lithopedion removed.

lying in a retroperitoneal position behind the ascending colon to which position it had apparently dissected after rupture from the right fallopian tube some time in the past. The right fallopian tube was indurated, elongated and adherent at its tip to the right colic gutter just inferior to the calcified mass. The mass itself was firmly attached posteriorly, but was readily removed by blunt dissection. The colon was reposited in the right colic gutter, the raw area reperitonized and the abdomen closed. The patient made an uneventful recovery and was discharged from the hospital on the eighteenth postoperative day.

The specimen (Fig. 5) was an irregular-shaped calcified mass that weighed 200 gm. and measured 11 cm. in its long axis, 8 cm. in its transverse axis and 7 cm. in thickness. The surfaces were irregular and bones of the extremities could be identified. At one extremity there appeared to be the head of a calcified fetus. The diagnosis was believed to be true lithopedion, or lithotecnon.

COMMENTS

Litbopedion: Lithopedions have been classified by Küchenmeister[8] into three groups: (1) Lithokelyphos (stone sheath or egg shell) in which the membranes alone are calcified and form a hard shell surrounding the fetus. The fetus may undergo only slight change or may be completely skeletonized, but is not involved in the process of calcification. (2) Lithokelyphopedion (stone-sheath child) in which both the membranes and the fetus are calcified. (3) True lithopedion (stone-child) in which the fetus is infiltrated with calcium salts and calcification of the membranes is negligible. This type results when the fetus extrudes, unattached, into the abdominal cavity, the mem-

branes being either left behind or very closely wrapped about the fetus.

Masson and Simon[4] proposed the term "lithotecnon" for the true lithopedion and reserved the name "lithopedion" for the entire group. The case reported herein belongs to the true lithopedion, or lithotecnon, class.

While many lithopedions remain in the abdomens of their hosts for years without causing trouble Anderson, Counseller and Woolner[3] state that a sufficient number result in serious disability, as in our case, to warrant the surgical removal of any dead abdominal fetus or lithopedion as soon as the diagnosis has been established.

Volvulus of the cecum: Donhauser and Atwell[5] state that torsion of the cecum may occur at any age, but in 50 per cent of cases it occurs between the ages of twenty and forty-five. They state it occurs in men and women in equal ratio. Christopher[9] reports the incidence to be four times as great in males as in females. The signs and symptoms are usually those of acute intestinal obstruction. Considerable distention and a mass are frequently present.

The roentgenologic picture is usually helpful only as showing the picture of intestinal obstruction, although there may be an unusually large amount of gas seen in the region of the cecum, particularly if the ileocecal valve is competent and a closed-loop obstruction results. Easton[10] described a means of roentgenologic diagnosis as follows:

"During the course of a barium enema, the column of barium is unable to pass beyond a certain point in the region distal to the cecum, i.e., in the ascending or transverse colon, so that the cecum cannot be properly delineated in its marking by the barium, and when, at the same time, a large collection of gas appears at the site of the cecum, indicating its patency and configuration, either in the midline or slightly to the right of it, this is a clear sign that volvulus of the cecum has taken place."

Rothman[6] suggested the procedure of an admission roentgenogram, followed by Wangensteen suction and enema; this to be followed by another roentgenogram and comparison with the previous film. In volvulus of the cecum the gas bubble remains in the same position with the same configuration or, in closed loop obstruction, may be slightly larger. The size of the gas bubble and the fluid level indicate colon obstruction and from the position to the right of the midline one may diagnose volvulus of the cecum.

Donhauser and Atwell[5] reported gangrene of the cecum in 25 per cent of the 100 cases they reviewed. Of these, 75 per cent reported for treatment before the fifth day. Most of those who survived, however, were operated upon within twenty-four hours of the onset of acute symptoms. Donhauser and Atwell state that the type of operation performed depends on the conditions encountered and has little effect on mortality figures, but the earlier the operation the better the results.

SUMMARY

An unusual case of intestinal obstruction and perforation of the cecum due to volvulus of the cecum is presented. This case is of further interest in view of the fact that the point of twisting of the volvulus arose at the site of adhesion of the ascending colon to a retrocolic lithopedion. The case was further complicated by atresia of the right main stem bronchus with either total atelectasis or congenital absence of the right lung, with a resultant marked shift of the mediastinum.

REFERENCES

1. Reeves, T. K. and Lipman, G. S. Lithopedion; report of case with review of literature. *Pennsylvania M. J.*, 44: 1548–1550, 1941.
2. Brandman, L. True lithopedion—incidental finding at necropsy and review of the literature. *Am. J. Obst. & Gynec.*, 54: 887–889, 1947.
3. Anderson, J. R., Counseller, V. S. and Woolner, L. B. Lithopedion: report of an unusual case and notes of two other cases. *Am. J. Obst. & Gynec.*, 62: 439–444, 1951.
4. Masson, J. C. and Simon, H. E. Extra-uterine pregnancy; lithopaedion. *Surg., Gynec. & Obst.*, 46: 500, 1928.
5. Donhauser, J. L., and Atwell S. Volvulus of the cecum. *Arch. Surg.*, 58: 129–148, 1949.
6. Rothman, M., Bruckner, J. P. and Zetena, D. F. Volvulus of the cecum and ascending colon. *Am. J. Surg.*, 60: 292–297, 1943.
7. Sweet, R. H. Volvulus of cecum, acute and chronic with reports of eight cases. *New England J. Med.*, 213: 287–293, 1935.
8. Küchenmeister. *Arch. f. Gynäk.*, 17: 153–259, 1881. Quoted by Brandman.[2]
9. Christopher, F. Textbook of Surgery, vol. 5. Philadelphia, 1950. W. B. Saunders Co.
10. Easton, E. R. and Adams, J. E. Incipient volvulus of caecum associated with left sided colon. *Surgery*, 1: 920–927, 1937.

FIBROSARCOMA OF BREAST WITH METASTASES TO AXILLARY LYMPH NODES

JEROME J. WEINER, M.D. AND ANGELO M. SALA, M.D.
New York, New York

SARCOMA of the breast is not frequent. Apparently the mesenchymal tissues of the organ are not as susceptible to neoplastic disease as the epithelial elements, otherwise, as Geschickter[1] aptly remarks "sarcoma rather than carcinoma would be the most frequent." In a group of 2,623 malignant tumors of the female breast tabulated by the same author[2] there were only sixty-two sarcomas of all types; twenty-nine were fibrosarcomas. Other authors have found mammary sarcoma equally infrequent, and reports in the literature usually concern small series. We think it desirable therefore to add our case to those already reported.

Fibrospindle cell sarcomas of the breast are usually divided into two classes, depending on whether the lesion is primary in the stroma, or secondary to a fibroadenoma, the existence of which has been known for some time, even years. The type that is primary in the stroma is apparently more frequent than the type that is secondary to fibroadenoma; of Geschickter's twenty-nine cases, eighteen were of the former type, eleven of the latter.

Metastasis to the axillary lymph nodes, encountered in our case, is a rare occurrence. Geschickter[1] writes that "involvement of the skin or the axillary nodes is usually absent." Cheatle and Cutler[2] state that "the axillary lymphatic glands are only rarely invaded by mammary sarcoma," and refer to a paper by Geist and Wilensky[3] who "in a large series of cases reported three per cent in which the axillary glands were affected." Distant, blood-borne metastases are the rule to which our case eventually proved to be no exception.

CASE REPORT

A. V., a white woman, aged sixty, mother of two children both delivered by cesarian section and both living and well, was seen by one of us (J. W.) for the first time on January 4, 1947, complaining of a mass in the right breast, which had been first noticed only two months previously, and had in the meantime been growing rapidly in size. There was a sensation of "pinching" in the affected breast. There was no history of a pre-existing mass. The patient stated that she had lost 12 pounds in the past two months. She had had her menopause at forty-eight, and it had been uneventful. There were no other salient facts in the past history.

The woman was rather poorly nourished and of small stature, and her skin was dry. In the upper and outer quadrant of the right breast there was a large mass, firm, irregular in outline and tender; it was apparently encapsulated but adherent to the pectoral fascia. The overlying skin was free and the nipple was not retracted, but the veins over the breast were markedly dilated. A large node was felt at the apex of the axilla; smaller, shotty nodes were felt medial to the larger node. The left breast and axillary fossa were not remarkable. A roentgenogram of the chest at this time did not disclose mediastinal or other metastases.

The patient was admitted to the Manhattan General Hospital on January 6, 1947, where under pentothal® and nitrous oxide anesthesia radical mastectomy and axillary dissection were done on the same day. The postoperative course was uneventful and the patient left the hospital nine days after operation.

Gross examination of the specimen showed a right breast, covered by skin which included the nipple, and with the breast came the pectoral muscles and axillary fat. The breast measured 18 by 12 by 9 cm. A very firm, seemingly circumscribed mass occupied a large area of the breast; it measured 9 by 8 by 8 cm. The gross appearance was that of solid, fleshy, grayish white tissue, with areas of softening. The cut surface showed small areas of hemorrhage; there were no cysts. In the axillary fat a lymph node 3 by 2.5 by 2 cm. and some smaller nodes were found; the larger node was grossly invaded by neoplasm. (Figs. 1 and 2.)

The histologic picture was typical, consisting of interlacing bands and whorls of fibrospindle

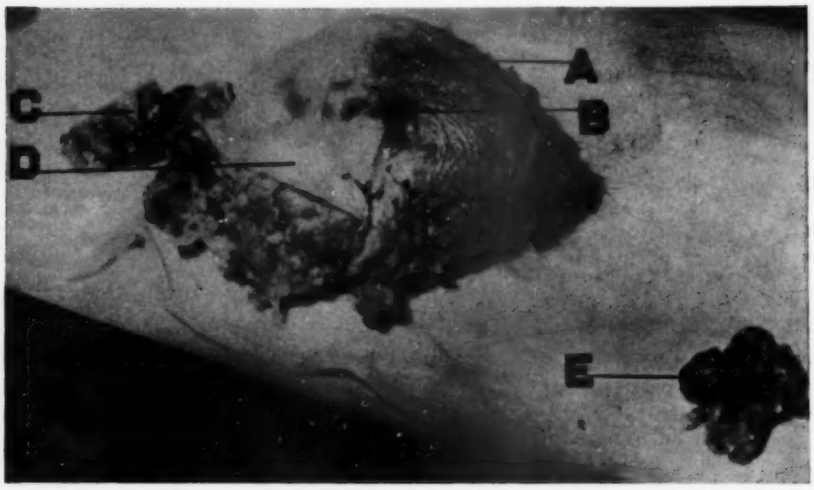

FIG. 1. A, nipple not retracted; B, dilated veins over tumor; C, pectoral muscles; D, site of tumor mass; E, axillary fat pad with lymph nodes.

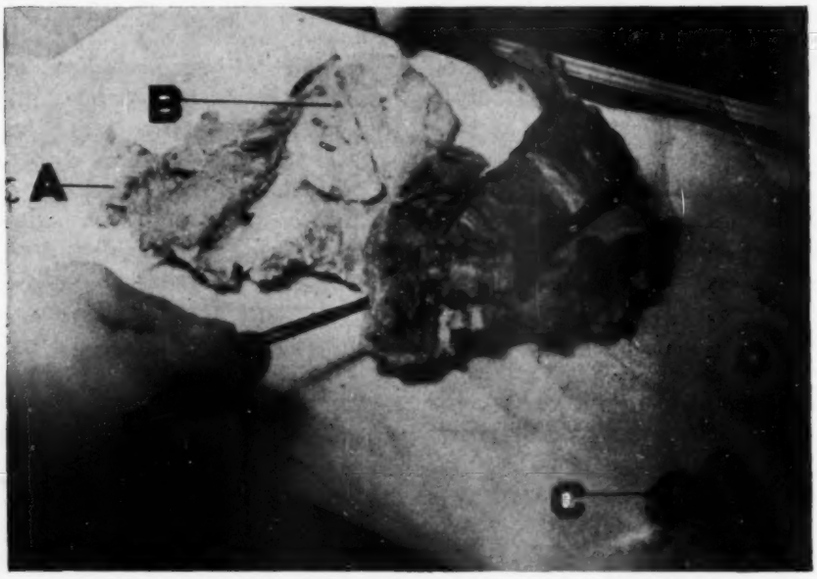

FIG. 2. A, pectoral muscles; B, tumor; C, axillary fat pad and lymph nodes.

cells, with large dusty or dense nuclei, irregular in size. Tumor giant cells and mitotic figures were present. (Figs. 3 and 4.) There were areas of myxomatous degeneration in several of the many slides examined, but neither the gross nor microscopic picture suggested giant mammary myxoma (cystosarcoma phyllodes, giant intracanalicular myxoma). Areas of hemorrhage were found on microscopic examination, as already noted in the gross specimen.

The patient died at home four months after operation; radiation therapy had been administered. Pulmonary and osseous metastases had become demonstrable by x-ray. It is interesting to note that they had not been demonstrable at the time of operation. Autopsy was not permitted.

COMMENTS

The treatment employed in this case was the only one with any conceivable chance of any good result. It was either that or no treatment at all. This type of neoplasm being definitely radio-resistant irradiation alone would not have altered the course of our case.

There are opposed views on the extent of surgery indicated in fibrospindle cell sarcoma of the breast. Cheatle and Cutler[2] affirm "complete agreement" with Deaver and McFarland's conclusion that "simple excision of the

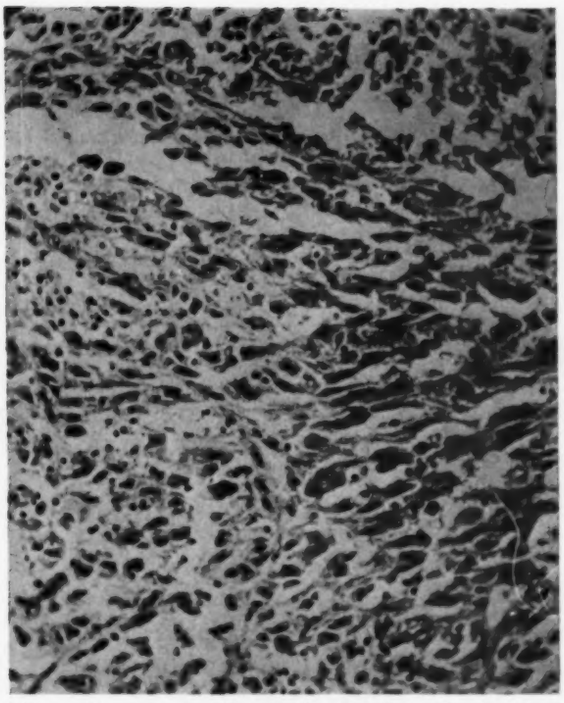

FIG. 3. Low power; interlacing bands and whorls of fibrospindle cells with large dense nuclei irregular in size.

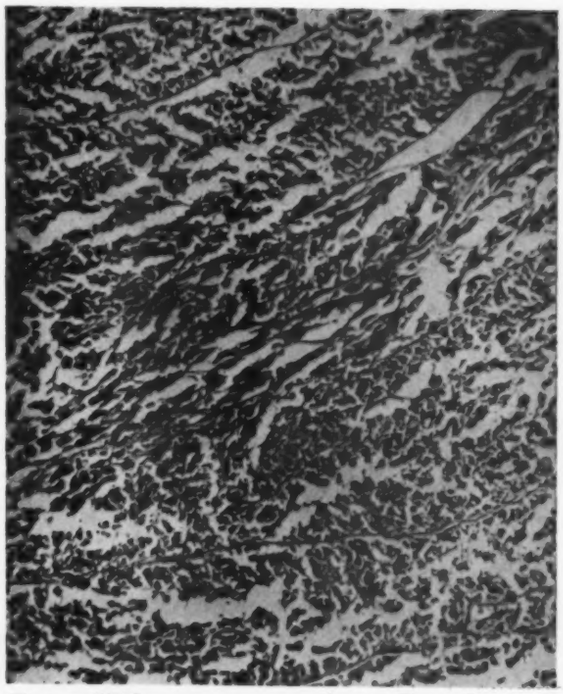

FIG. 4. High power; tumor giant cells and mitotic figures.

tumor is justifiable only in exceptional instances and that the safest plan is to advise radical amputation in every instance." He mentions, apparently with approval, Bloodgood's recommendation that the pectoralis major muscle be taken as in the radical mastectomy.

Cheatle and Cutler do not mention axillary dissection, and one may assume that they approve it along with the radical mastectomy. Geschickter[1] recommends that "if a palpable and large gland is found, however, this may be taken for biopsy. If a sarcomatous deposit is found, the prognosis is grave but the axillary dissection does not add to the probabilities of cure and should not be performed."

The difficulty of decision is obvious from what had been stated previously. It is our belief that given another case than the one reported, we should recommend the same procedure. We are quite convinced that axillary dissection is not likely to add to the probabilities of cure but, on the other hand, it cannot possibly subtract from such probabilities, and nowadays it does not add to the operative risk. Irradiation is probably altogether worthless.

SUMMARY

A case of mammary sarcoma primary in the stroma is reported. It was characterized by: (1) marked rapidity of growth; (2) clinically demonstrable involvement of the axillary lymph nodes within a period of two months after the tumor was first noticed by the patient; (3) death of the patient within six months, in spite of radical mastectomy and axillary dissection two months after first notice of the tumor and postoperative radiation; and (4) appearance of pulmonary and osseous metastases before death.

REFERENCES

1. GESCHICKTER, C. F. Diseases of the Breast, 2nd ed., p. 379. Philadelphia, 1945. J. B. Lippincott Co.
2. CHEATLE, G. L. and Cutler, M. Tumors of the Breast, p. 508. Philadelphia, 1931. J. B. Lippincott Co.
3. GEIST, S. H. and WILENSKY, A. O. Sarcoma of the breast. *Am. Surgeon*, 62: 11, 1915.
4. HARRINGTON, S. W. and MILLER, J. M. Fibrosarcoma of the mammary gland. *Surgery*, 7: 129, 1940.
5. ADAIR, F. E. and HERMAN, J. B. Sarcoma of the breast with a report of 30 cases. *Surgery*, 19: 56, 1946.
6. SAILER, S. Sarcoma of the breast. *Am. J. Cancer*, 31: 183, 1937.
7. ISIDOR, P. Critical study of sarcomas of breast. *Gynaecologia*, 33: 382, 1934.
8. BERARD, L., MARTIN, J. F. and HENRY, M. A case of myosarcoma. *Lyon chir.*, 34: 60, 1937.
9. FUNCK-BRENTANO, P., BERTRAND, I. and POILLEUX, F. Phylloid tumors of the breast (cysto-

sarcoma of Johann Müller). *J. de chir.*, 51: 506, 1938.
10. Adair, F. E. and Herman, J. B. Primary lymphosarcoma of the breast. *Surgery*, 16: 836, 1944.
11. Napoleao, D. Sarcoma of the breast in a girl aged 15. *Rev. de ginec. e d'obst.*, 25: 115, 1931.
12. Cohen-Solal, L. Sarcoma of breast: two cases. *Practicien du Nord de l'Afrique*, 5: 16, 85, 1932.
13. Banet, V., Bolaños, J. M. and Sutter, R. Osteogenic sarcoma of the breast. *Bol. Liga contra et cáncer*, 8: 321, 1933.
14. Fox, S. L. Sarcoma of the breast. *Ann. Surg.*, 100: 401, 1934.
15. Diechamp. Enormous fibrosarcoma of the right breast in a young girl. *Loire méd., St. Etienne*, 17: 294, 1898.
16. Schreiner, B. F. and Thibaundaue, A. A. Sarcoma of the breast. A report of seven cases. *Ann. Surg.*, 95: 433, 1932.

Occasionally the thoracic duct is injured or later eroded into, in patients sustaining empyema operations, sympathectomies, resection of esophagus, etc. Chylothorax is often followed by a 50 per cent mortality. The thoracic duct delivers 50 to 200 cc. of chyle into the circulation every hour and when badly damaged this loss of fluid, fat, protein and lymphocytes, seriously affects the patient's nutrition. Many cases of traumatic chylothorax heal spontaneously and the patient need be given only suitable supportive treatment. However, occasionally a surgical operation is needed; and unless the tear or opening in the thoracic duct is effectively closed, the prognosis becomes very grave. In many cases simple ligation of the duct and/or of the cisterna chyli is needed. Nature often effects a cure, in these ligated cases as well as many treated conservatively, by the development of a collateral circulation. Patients sustaining crushing chest injuries should be carefully examined for injury to the thoracic duct. If a pinkish and turbid, almost purulent-appearing fluid, accumulates in such a patient's chest, that surgeon must consider the possibility of chylothorax and not jump to the conclusion it is a simple case of empyema. (*Richard A. Leonardo, M.D.*)

MONDOR'S DISEASE

CORD-LIKE PHLEBITIS OF ANTEROLATERAL WALL OF THORAX

JAMES N. CIANOS, M.D.

Baltimore, Maryland

THE first description of this disease entity was noted by the French surgeon, Henri Mondor, in Professor Tixier's "Livre Jubilaire."[1] In 1939 Mondor presented ten personal cases, with ten more collected from the literature. Leger[2] in 1947 culled twenty-two cases from the literature and reviewed the possible etiology, symptoms, pathology and treatment. Ferron and Senechal[3] in 1949 and later Kopanitoff, Tourzard, and Darbon[4,5] presented additional personal cases. A review of the American literature failed to shed any additional information on this syndrome. No references to it could be found.

Leger[2] noted that this disease is more frequent in females between the ages of twenty-five and fifty-five years. It first appears as a cord-like band adherent to the skin and subcutaneous tissues with retraction of the skin giving it a "peau d'orange" appearance. Usually the lower anterolateral thoracoabdominal wall is involved, the cord-like structure being about 20 to 30 cm. in length. The terminations usually blend or there may be two or more arborizations spreading out from the lower most portion over the upper abdominal wall. In two cases double cords were observed along the left anterior axillary wall.

The onset is insidious. No definite etiologic factor has been demonstrated. Most frequently pain occurs which is increased by deep breathing. In some cases the linear cord is observed only when the arm is abducted. Usually there is no adenopathy or abnormality of the breast. In the first case described herein chronic cystic mastitis was a coincidental finding. X-ray of the chest is normal and there is usually leukocytosis with an increase in eosinophils and monocytes. Bacteriologic studies reveal no additional information.

Histologically, one notes small veins and lymph vessels showing subacute obliterative endophlebitis with some thrombosis. Vascular tissue in some cases is replaced by dense fibrosis or desmoplasia. The thoracoepigastric and long thoracic veins are those which seem to be involved.

The lesion is benign and no treatment is necessary except in the presence of pain when the structure is extirpated. One case was followed up for eight years with no untoward results.

CASE REPORTS

CASE 1. The patient was a thirty-three year old white married female, admitted to St. Agnes Hospital on November 14th and discharged on November 15, 1949. Three weeks before admission pain had developed in and around the left breast. This pain started with the onset of catamenia and was associated with the appearance of a fibrous band starting in the upper left quadrant and spreading downward for 4 inches. In the last few days the lesion had grown about 2 more inches. The past history revealed a miscarriage in 1949 but was otherwise negative. A review of the systems was non-contributory.

On examination the heart and lungs were clear. The blood pressure was 126/82. In the left outer quadrant of the left breast there was a subcutaneous fibrous band about 6 inches long that curved downward around the nipple. At its distal extremity the band divided into a fork-like arborization and branched laterally. It was not tender and felt as if a ureteral catheter were threaded into the subcutaneous tissues. The remaining breast showed no abnormality.

A teleroentgenogram of the chest taken on November 15, 1949, was negative. The urine was normal. The Kahn and Hinton tests were negative. Blood chemistry showed urea 18 and sugar 113. The serum calcium and phosphorus were 10.9 and 2.8 mg., respectively. Blood count showed hemoglobin 85 per cent, red blood cells 4,410,000 and white blood cells 5,150.

Because of the pain and the unknown nature of the lesion, several segments were removed

under sodium pentothal® anesthesia and were examined by frozen and permanent section.

Grossly, the tissue was unidentifiable. It seemed to consist of a rather fibrous center surrounded by some adipose tissue. Under microscopic examination a normal adipose tissue background was seen in which structures were distributed which on cross section appeared relatively cylindic. These structures were composed of dense, compact, fibrous tissue showing early hyalinization. In the vicinity interstitial breast tissue was found, showing increased density with a tendency toward fibrosis and hyalinization. Slight dilatation of the ductal system was seen. However, the epithelium was normal and inflammatory changes, although present in the form of slight leukocytic infiltration, were minimal.

CASE II. This patient was a sixty-two year old white woman who was admitted to St. Agnes Hospital on April 4, 1952, because of "breast lumps." She first noted a small mass in the left breast one year before admission. At that time she had injured her left arm and in the process of heat treatment and massage, the lesions were noted. Three small masses were found which caused no pain or evidence of increase in size or change in the overlying skin. No other symptoms were noted.

Physical examination revealed no abnormality except for that in the left breast. A small, hard nodule about the size of a small pea was located at 10 o'clock about 7 cm. from the nipple. This was non-tender and fixed to the surrounding tissue. Another similar mass was palpated at 9 o'clock about 5 cm. from the nipple.

Microscopic examination of the excised tissue showed a compact fibrous mass infiltrated rather heavily with lymphocytes. This fibrous tissue appeared to be interstitially between masses of fatty tissue and appeared to be a laminated, organized substance, possibly thrombosis.

It is possible that areas of necrosis and thrombosis corresponding to small veins present a case of Mondor's disease.

SUMMARY

Two cases of an unusual lesion have been described which were at first confused with disease of the breast because of its proximity to the pathologic process. A review of the symptoms, pathology and treatment is given together with the meager bibliography that could be found in the French literature.

REFERENCES

1. MONDOR, H. In: Livre Jubilaire du Prof. Tixier. *Mém. Acad. de chir.*, p. 1271, Dec., 1939; p. 96, March, 1944; p. 445, Dec., 1944.
2. LEGER, L. Cord-like phlebitis of antero-lateral wall of thorax; inflammatory condition described by Mondor. *Presse méd.*, 55: 849–851, 1947.
3. FERRON, E. and SENECHAL, J. J. Mondor's disease (subcutaneous inflammation of antero-lateral thoracic wall); two cases. *Bordeaux chir.*, pp. 60–61, 1949.
4. KOPANITOFF, M. G., TOURZARD, M. M. and DARBON. Mondor's Disease. Six personal cases. *Mém. Acad. de chir.*, 76: 939–945, 1950.
5. KOPANITOFF, M. G. A new case of Mondor's disease. *Mém. Acad. de chir.*, 76: 945–947, 1950.

ENDOMETRIOSIS: AN INCREASING SOCIAL AND SURGICAL PROBLEM

HARRY H. DANAHER, M.D.
Green Bay, Wisconsin

IN the short space of a little over fifty years endometriosis has become a very common disease found at surgery; whereas previous to that time it was rarely noted. There is little argument that the condition is progressively increasing but the reasons for this are not clear. Most likely the disagreements on the etiology of the entity cloud the issue. Meigs[1] advocates late marriage, delayed gestation and infrequent pregnancies as common causes for the increase. Javert,[2] a proponent of the Sampson reflux theory, adds fewer cervical dilations and uterine suspension operations, and greater use of intravaginal tampons during menstruation. Other observers believe that the decrease in occlusive salpingitis has allowed increased reflux of menstrual fluid in a greater number of instances.

Any disease that is on the increase merits greater attention, and prevention as well as treatment of the established condition are of equal importance. The facts that many young couples are deprived of parenthood, many women are subjected to repeated attacks of pelvic pain and discomfort, and a certain percentage of these women will eventually require major surgery are reasons enough for an active campaign against this condition.

The following case reports are quite typical of many that every surgeon will meet in his practice.

CASE REPORTS

CASE I. Mrs. L. N., age thirty-six, gravida 0, was first seen on September 10, 1952. Her entering complaint was more frequent menstrual periods accompanied with increasing pain. The last menstrual period was on August 30th. The menarche occurred at thirteen years of age, every eighteen to twenty days, lasting three to five days. Bleeding was moderate and there was increasing moderate dysmenorrhea but no molimina. The patient denied dyspareunia and the use of contraceptives at any time. Pelvic instrumentation was never done and intravaginal tampons never used. The patient was married at age twenty-eight. Shortly after marriage she was told she had a "tipped womb" and suspension was advised, which she refused. On entrance examination pertinent findings were a fixed, tender, orange-sized mass in the right adnexal region. A golf-ball-sized, firm, non-tender mass was present at the anterior, right uterocervical junction. The uterus was anterior at this time and the masses posterolateral to it. Sounding of the cervix revealed partial stenosis at the internal os. Laparotomy performed on October 7th revealed the right adnexal mass to be an endometrial cyst without any normal ovarian tissue remaining. The left adnexal mass was an endometrial cyst with about one-half of the normal ovary remaining. The mass at the uterocervical junction was a subserous fibroid. Removal of both cysts, fibroid and appendix was done. As the patient still desired any opportunity for child-bearing the conservative operation was performed. Postoperative course was uneventful and painless menstruation has occurred.

CASE II. Mrs. M. B., age thirty-seven, gravida 0, was first seen on September 19, 1952. Her entering complaint was more frequent, irregular menstrual periods. Her last menstrual period was on September 9th. The menarche occurred at eleven years of age, every fifteen to thirty-one days, lasting two to eight days. Bleeding was heavy with large clots and there was increasing moderate dysmenorrhea and marked molimina. The patient reported moderate dyspareunia and denied birth control at any time. Intravaginal tampons were never used. Appendectomy and right salpingo-oophorectomy were performed when the patient was nineteen. She married at the age of twenty-eight. Diagnostic dilatation and curettage had been done in 1947 for infertility. In 1951 the patient had been told she had a "tipped womb." Examination in November, 1952, re-

vealed a left adnexal fixed mass the size of a small lemon and third degree fixed retroflexion of the uterus. The cervical canal was patent. Laparotomy was performed on November 7th and revealed an endometrial cyst on the left and a fibroid uterus. Total hysterectomy and left salpingo-oophorectomy were done as no normal ovarian tissue was left. The postoperative course was uneventful.

COMMENTS

The foregoing cases parallel each other closely regarding age, complaints, infertility and late marriage. Treatment will vary considerably regarding extent of pathologic condition, age, parity and desire for more children. Discussion of treatment is not in the scope of this paper as many excellent articles are available.[3,4]

The Sampson retrograde menstruation theory would seem to explain an increasing incidence best. Therefore preventive measures should be directed toward the prevention of reflux of menstrual fluid through the tubes. Every pelvic examination in which there is no question of pregnancy should include sounding of the cervical canal to rule out obstruction. Needless to say this is almost always neglected by most examiners. Fixed retro displacement should be considered as surgical indications in the child-bearing age. Suspension operations have fallen into disrepute because of abuse but are definitely indicated when well selected.

Social aspects of endometriosis are far-reaching and more difficult for the physician to solve. Meigs[1] advocates earlier marriage and early and more frequent pregnancies. The family physician can best encourage young couples to start having children soon after marriage and to have a greater number than is usually the case.

Explanation of the possible effects of long-delayed gestation should be made at premarital examinations. Examination of the female partner as well as the male should be routine, and wherever possible sounding of the cervix should be done. More research is necessary to determine if intravaginal tampons are hazardous. Forceful pelvic examinations during any phase of menstruation should be limited to very definite indications, and no pelvic examination should follow dilatation and curettage immediately postoperatively unless absolutely necessary. Tubal insufflation and hysterosalpingography are best performed prior to ovulation not only for best therapeutic and diagnostic results but also to prevent reflux of free desquamated endometrial tissue through the tubes. Intercourse during any phase of vaginal bleeding irregardless of how minimal should be interdicted. The Hebrew faith incorporates this in their religious laws, and it is interesting to note that endometriosis is of much lower incidence in Israel.[5] Whether or not this is a factor can only be speculated on but is suggestive.

SUMMARY

1. Endometriosis is definitely on the increase.

2. Sampson's theory of retrograde menstruation best explains the possible causes for increasing incidence.

3. Sounding of the cervical canal should be routine during every pelvic examination in which pregnancy is absent, and dilations should be done when stenosis is found.

4. Fixed retro displacements should receive surgical correction during the child-bearing period.

5. More research should be done to determine possible etiologies explaining the reasons for increase in a condition of such social significance robbing young couples of parenthood and making young women monthly cripples and pelvic invalids in the moderate and advance cases.

REFERENCES

1. Meigs, J. V. Panel discussion on endometriosis. Section on obstetrics and gynecology, 97th annual session, A. M. A. Chicago, 1948.
2. Javert, C. T. Observations on pathology and spreading of endometriosis based on theory of benign metastasis. *Am. J. Obst. & Gynec.*, 62: 477–487, 1951.
3. Huffman, J. W. External endometriosis. *Am. J. Obst. & Gynec.*, 62: 1243–1261, 1951.
4. Counseller, V. S. and Crenshaw, J. L., Jr. Clinical and surgical review of endometriosis. *Am. J. Obst. & Gynec.*, 62: 930–942, 1951.
5. Brzezinski, A. and Bromberg, Y. M. *Acta med. Orient.*, 10: 173, 1951.

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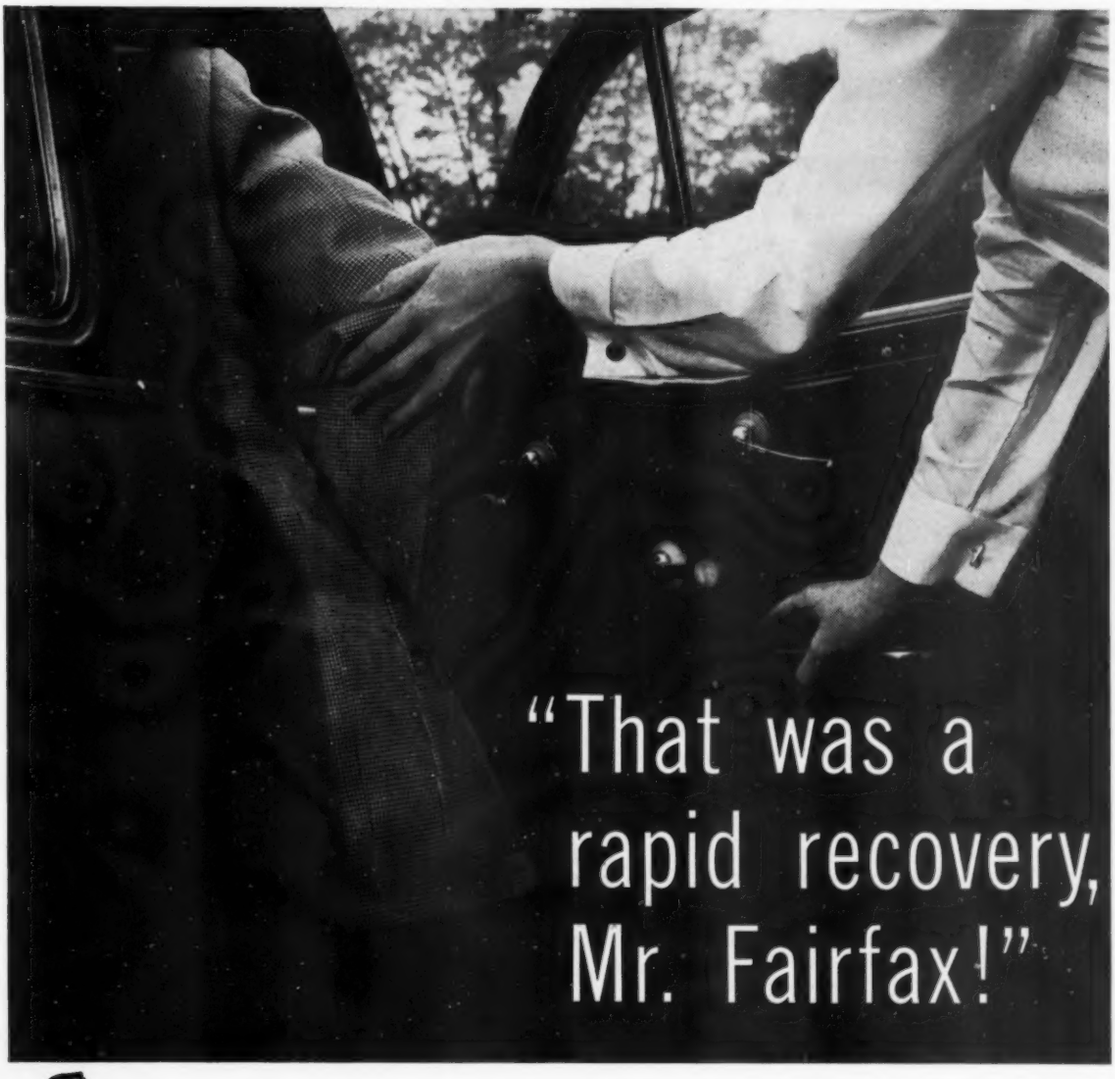

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1. Fox, C. L. Jr., et al.: An Electrolyte Solution Approximating Plasma Concentrations with Increased Potassium for Routine Fluid and Electrolyte Replacement, J. A. M. A., March 8, 1952.

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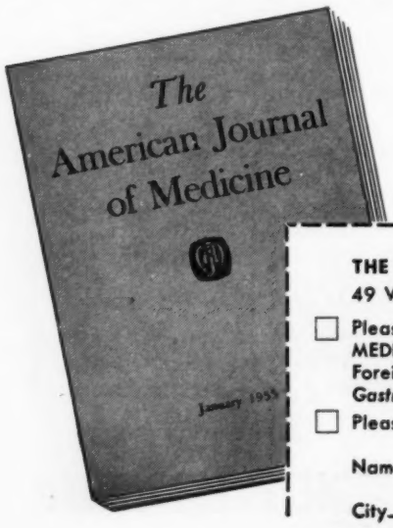

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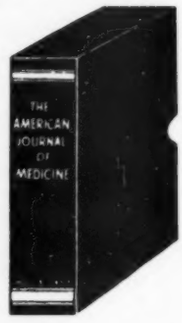

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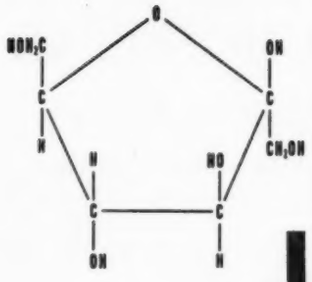

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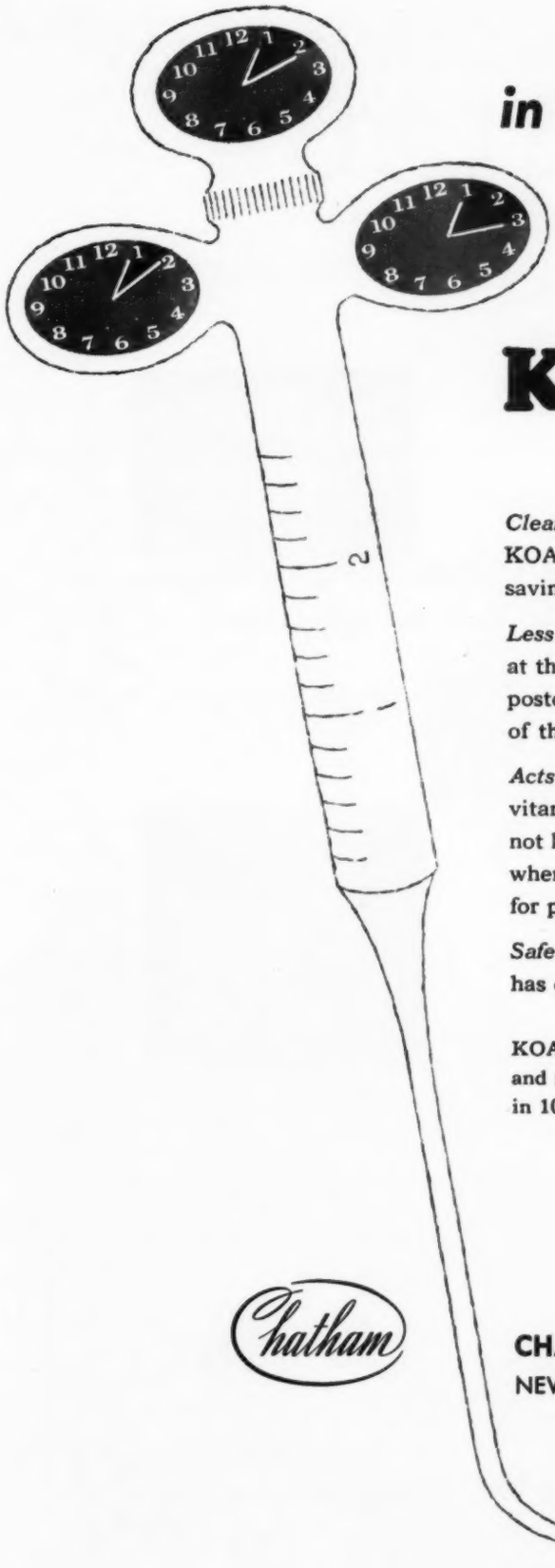

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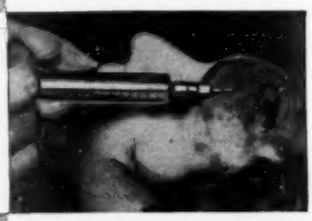

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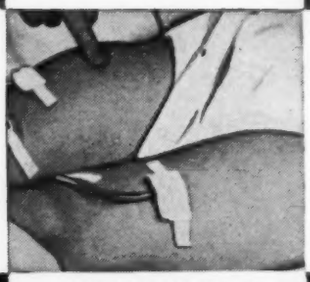

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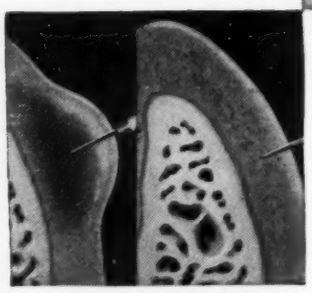

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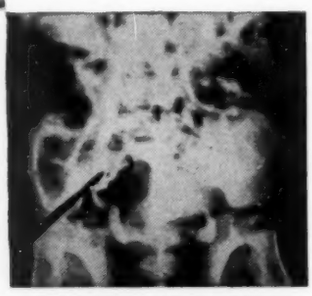

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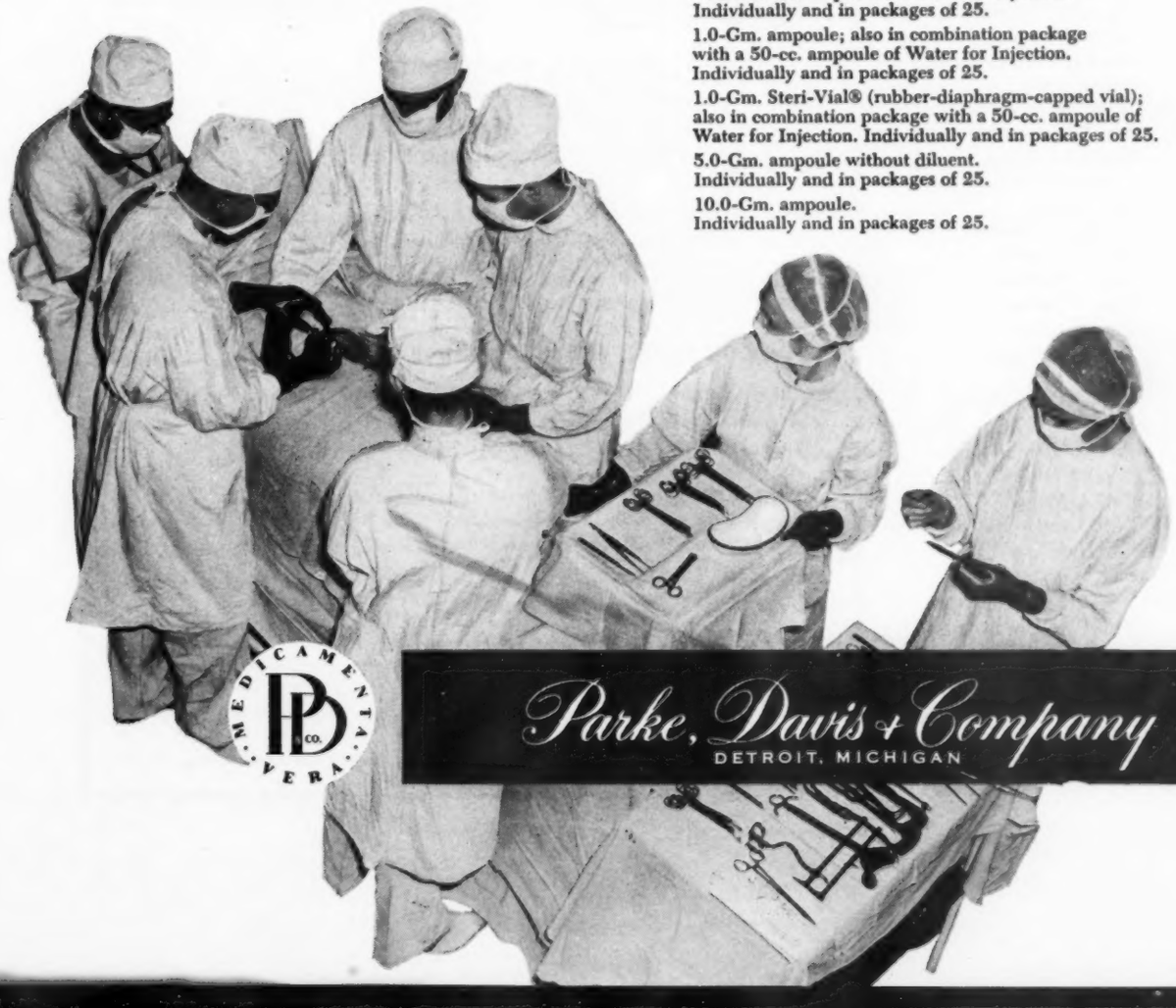

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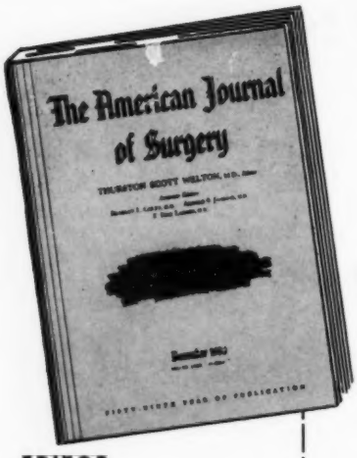

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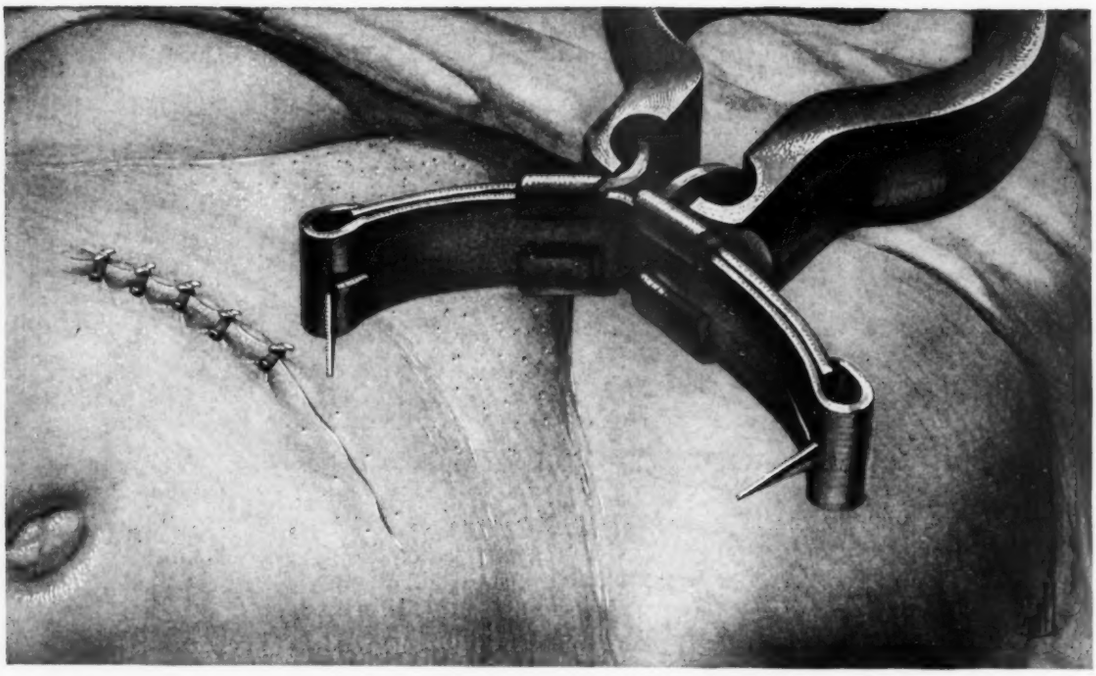

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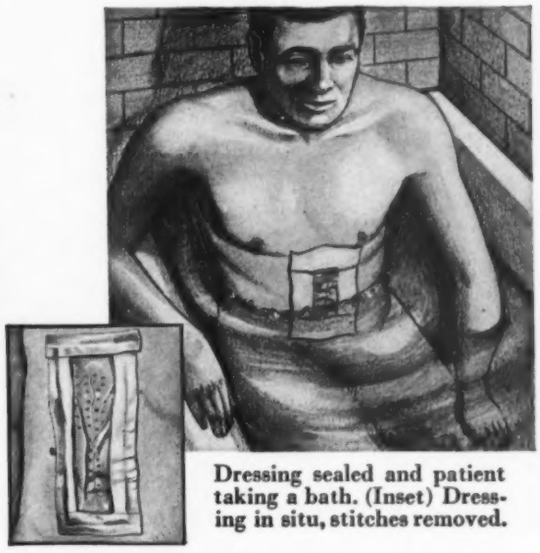

Dressing sealed and patient taking a bath. (Inset) Dressing in situ, stitches removed.

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Apply directly over sutured wounds

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Vitamin A	5000 units
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Thiamine hydrochloride	10 mg.
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Niacinamide	100 mg.
Calcium pantothenate	40 mg.
Pyridoxine hydrochloride	5 mg.
Choline bitartrate	500 mg.
Folic acid	2.5 mg.
Vitamin B_{12} (crystalline)	4 mcg
Iron	15 mg.
Calcium	6.3 Gm.
Phosphorus	4.5 Gm.
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References: "Internal Contact Splint" —Eggers, G.W.N.
Jour. Bone & Joint Surg., 30-A, No. 1, Jan. 1948
"The Influence of The Contact-Compression Factor on Osteogenesis in Surgical Fractures" — Eggers, G.W.N., Shindler, T.O. and Pomerat, C.M.,
Jour. Bone & Joint Surg., 31-A, No. 4, Oct. 1949

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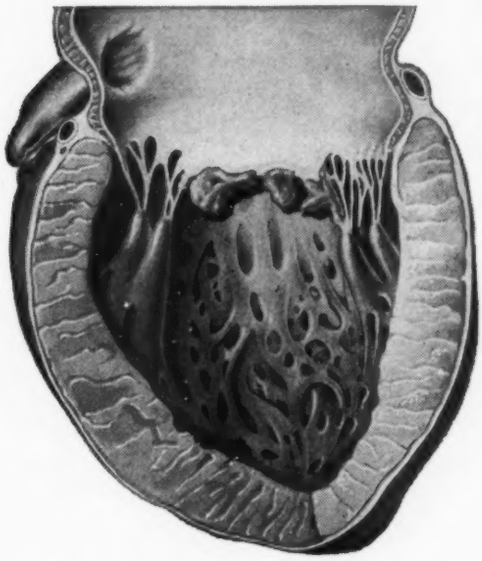
Treatment of choice in

Enterococcal Bacterial Endocarditis



"At present the treatment of choice in enterococcal subacute bacterial endocarditis is a combination of penicillin and dihydrostreptomycin . . . When subacute bacterial endocarditis is produced by an unknown organism [every effort having been made to identify the causative organism], a combination of these two drugs should be used."[1]

PENSTREP supplies this combination in convenient form. Supplementary penicillin is required during initial treatment.

Literature on request

1. Wellman, W. E.: *Postgrad. Med.* **12**: 167, August 1952.

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Catalog No. 149

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The McCarthy Deflecting Foroblique Pan-endoscope consists of telescope with deflecting mechanism, 24 Fr. sheath with obturator, conducting cord, contact, two extra lamps, catheter clip, Luer lock stop cock, Luer nipple, cleaning rod, assorted rubber tips, lamp wax complete in walnut case.

The instrument has a special 24 Fr. sheath, with a lengthened fenestra and obturator. The telescope is mounted in a deflecting mechanism which fits snugly in the sheath by means of a cone and bayonet lock. Three catheter openings are provided in the cone to accommodate one 10 Fr. or two 7 Fr. catheters. An elevator is located at the distal end of the telescope and is controlled by a deflecting mechanism located near the proximal end of the telescope. The optical system of the telescope is a special foroblique system designed to provide maximum field of vision, high definition and maximum light transmission.

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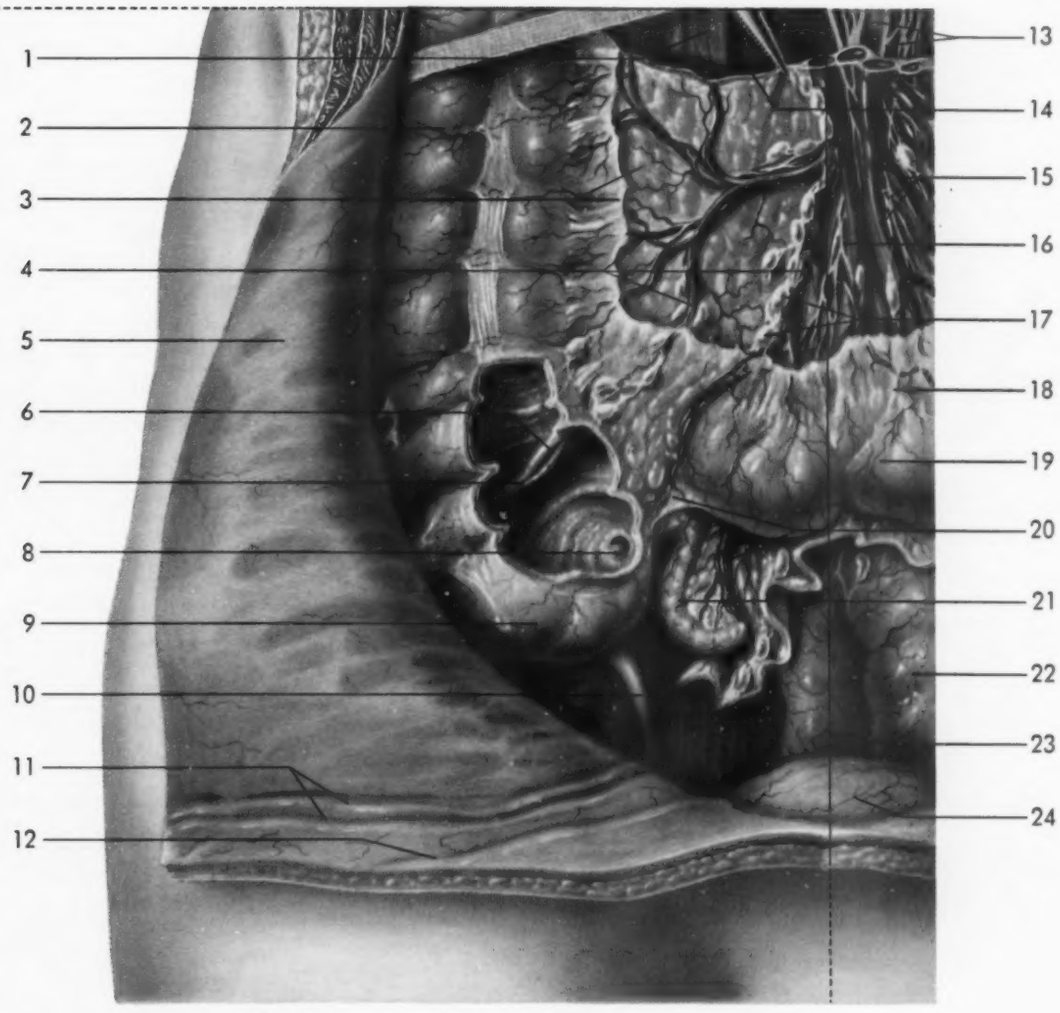
Lower Right Quadrant of the Abdomen



1 Spermatic artery and vein
2 Ascending colon
3 Mesocolon
4 Branches of ileocolic artery and vein
5 Parietal peritoneum
6 Ileocecal valve
7 Frenum
8 Appendicocecal valve
9 Cecum
10 Ureter and external iliac artery and vein
11 Epigastric artery and vein
12 Lateral umbilical ligament
13 Aorta and abdominal aortic plexus
14 Vena cava
15 Intestinal arteries and veins
16 Sympathetic abdominal plexus
17 Ileocecal lymph nodes
18 Mesentery
19 Ileum
20 Ileocecal fold and appendicular artery and vein
21 Vermiform appendix
22 Sigmoid colon
23 Rectum
24 Urinary bladder

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As an adjunct to surgery
in APPENDICITIS
and its complications—

Aureomycin

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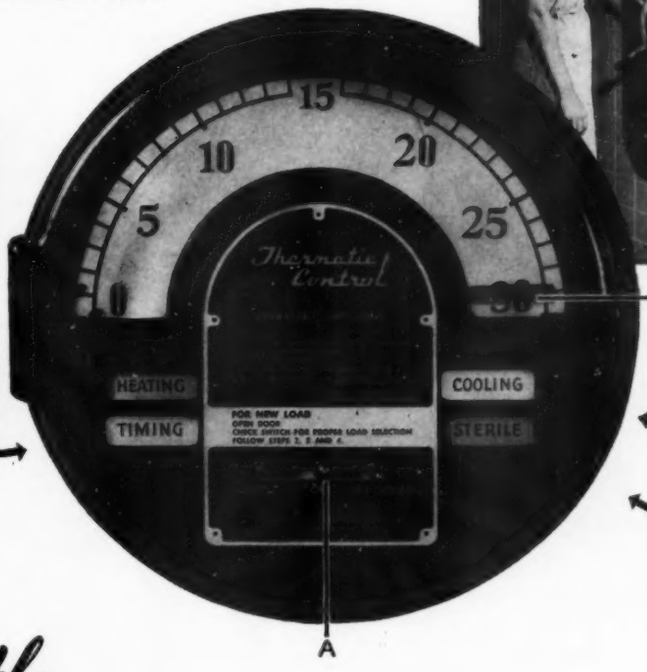
. . . indicates phase of sterilizing cycle in progress. Shows unelapsed time of exposure period (B)

. . . cross-the-room visibility that eliminates inspection trips.

. . . one flick of the control switch (A) sets the stage, and all successive phases: chamber heating, sterilizing, and cooling, automatically occur in proper sequence, as one uninterrupted cycle.



HEATING (Red)
indicates heating of the chamber.

TIMING (Yellow)
indicates load being exposed to sterilizing temperature.

COOLING (White)
indicates sterilization complete and chamber pressure reducing.

STERILE (Green)
indicates sterile load ready for safe removal.

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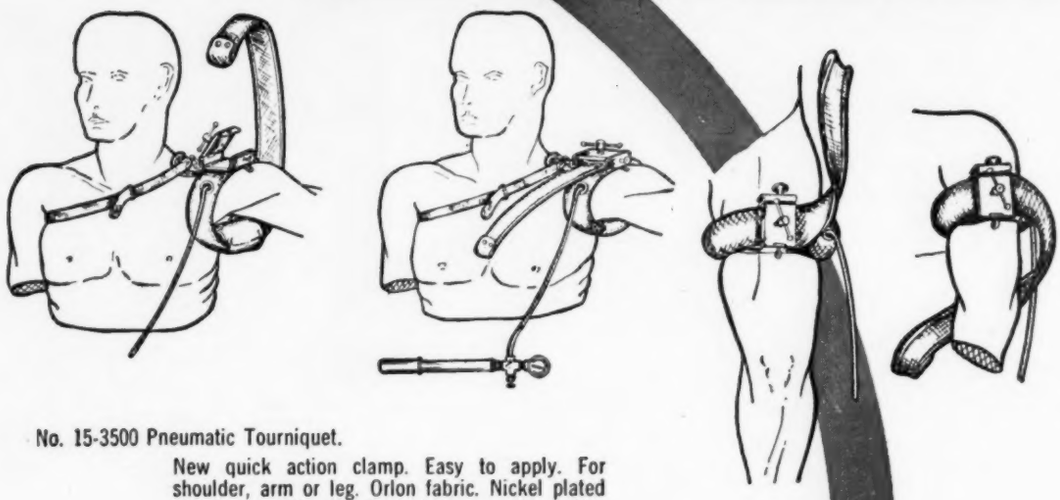

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supplemental medication during venoclysis

IMMEDIATELY

and without second venipuncture

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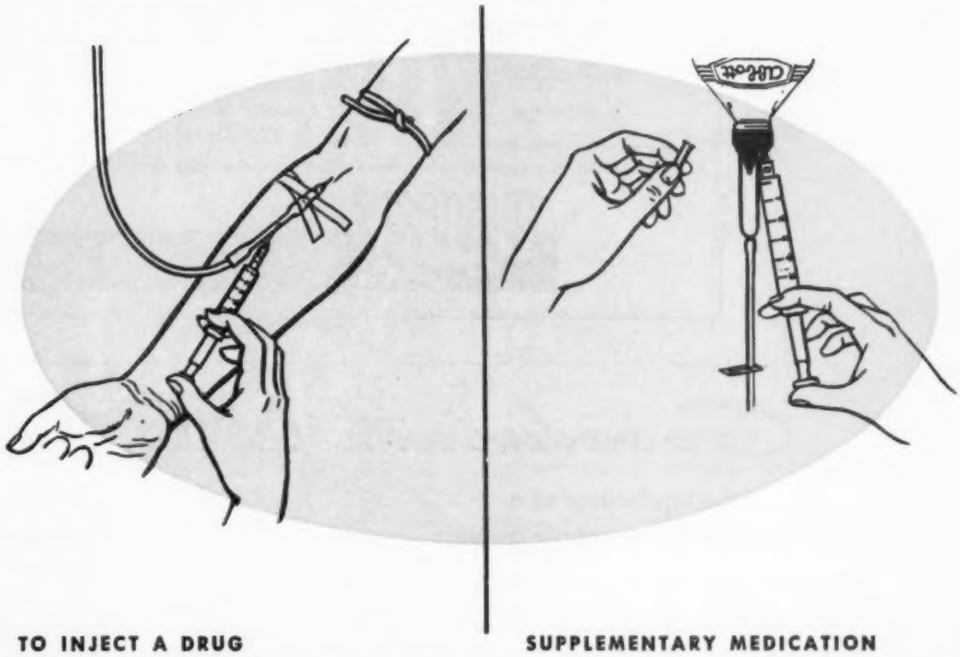

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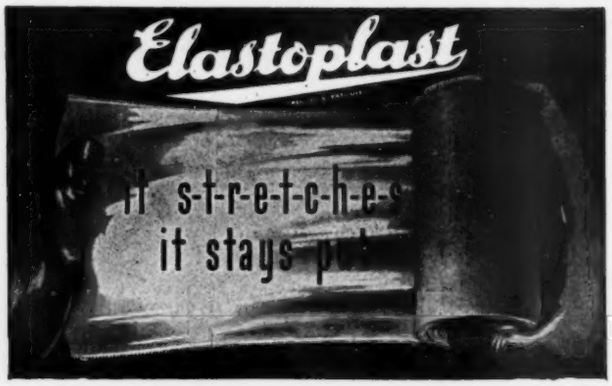

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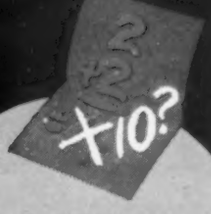

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Outside the Ivory Tower

A LONG-FELT need for reaching medical students with information on new developments in the field has been met by Techniques and Materials, an organization set up to circulate technical information to colleges. Techniques and Materials has been functioning successfully for the past three years in selected fields and at the present time is extending its scope to medical and allied schools. Based on requests from medical and pharmacy schools all over the country, this organization has set up a series of rotating exhibit circuits which services a selection of the country's leading schools.

These schools undertake no obligation or responsibility other than to assign to Techniques and Materials a space in a corridor, library, classroom, lecture hall or a laboratory where the maximum number of students and instructors can study these exhibits.

The exhibits are in each case sponsored by public agencies and manufacturers interested in presenting technologic data concerning new products, materials and methods in the field of medicine. All expenses involved in preparing and manufacturing, shipping and installing these exhibits are borne by the group sponsoring them.

Techniques and Materials installs in each school a basic exhibit unit which remains as a semi-permanent piece of equipment for the school year. On the background unit is placed at two-week intervals throughout the school year different exhibit panels. Each panel tells about a new subject; thus by rotation a thirty-week schedule permits fifteen varied exhibits on fifteen subjects. This material is designed and constructed by Techniques and Materials and is delivered and maintained by its trucks and personnel.

For Techniques and Materials the underlying principles of its organization are important. It realizes that the fundamental appeal to the schools lies in the selection of pertinent subject matter as well as an interesting and functional approach to content. This conditions its relationship with sponsor groups. Subject matter is dealt with on a high ethical and scientific level. The tone of the entire project is, from the sponsor's point of view, an institutional one; for the schools, an academic one.

Material is supplied by research groups, in all cases assembled, and in some cases actually developed for this series of exhibits. All materials are carefully edited by Techniques and Materials in order to maintain the levels indicated. Techniques and Materials will endeavor to bring to each school leading exponents in the same fields in subsequent yearly circuits.

All this is done with the use of the most dynamic and creative means possible. Because these exhibits are three dimensional they have the obvious advantage of being able to present actual sample materials and to provide graphic demonstrations of processes through cut-away views, models, illuminated color transparencies, art work and other readily understood visual means.

The personnel of Techniques and Materials is composed of experts with many years of background training in technical, medical, pharmaceutical and public health exhibits. To date an enthusiastic response from schools receiving this material has proved it of great value to both students and teachers.

EXPERIENCE has clearly shown, Mr. Van Dyk, Vice-President, Associated Hospital Services of New York, declared, that those Blue Cross Plans which have maintained and improved their service benefits even though they had to increase rates "have been the most successful, not only financially but from the viewpoint of growth and public participation. This is a clear indication that the public seeks a full measure of protection and is willing to pay for it. Moreover, as costs of hospital care increase, there is a corresponding increase in the need for protection against such higher costs."

AS compared with the conditions prevailing ten years ago, more than 15,000 lives were saved in the United States during 1951 and 1952 by the reduction in mortality from the common childhood diseases, according to the statisticians of the Metropolitan Life Insurance Company. Measles, whooping cough, diphtheria and scarlet fever were responsible for 3,400 deaths in the past two years, instead of the 19,000 which would have occurred if the rates of only a decade ago had continued unchanged.

(continued on page 56)

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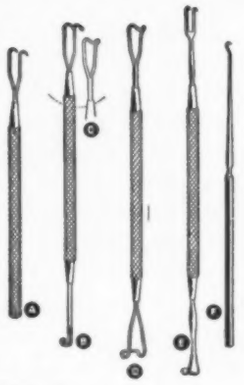

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Outside the Ivory Tower

(*continued from page 54*)

EVERYONE talks about chiggers, but few people ever do anything about them—except suffer! In a new book, "A Manual of the Chiggers," a Duke University scientist says you can do something about the small, six-legged mites that feast on men and animals. Dr. George Wharton, Duke zoologist, advises that if you know chiggers' habits, you can avoid them. For instance, the book includes studies done at Duke which indicate that when ground temperature rises above 60 degrees you can be certain that chiggers are lying in wait in undisturbed soil, a heavy population of small animals, and thicket or scrub type vegetation. If you are going camping, your site probably will have some scrub vegetation. Avoid it! Around your house, you can eliminate chiggers with any of a number of preparations recommended by the U. S. Department of Agriculture. Chiggers operate the year around, but those found on the American continent (Trombicula alfreddugèsi) feast only during the warm weather. The American chigger is just a pest species, but its relatives in the Far East carry scrub typhus. So far scientists have learned very little about treating the skin bites. Some salves containing an antihistaminic and a local anesthetic, applied once a day, will relieve itching, Dr. Wharton says. But it is not difficult to protect yourself against the little monsters. Many chemicals are available to be applied around openings in clothing or for complete impregnation of clothing. Some applications will repel chiggers for a month.

IN both the United States and Canada accidents constitute the greatest single threat to the lives of children one to four years of age. About 5,500 deaths, or one-quarter of the total that occur annually among preschool children in the two countries, result from mishaps of one kind or another.

ENROLLMENT of 250,819 new members in United Medical Service, New York's Blue Shield Plan, during 1952 brought the year-end total to 2,719,882, Dr. Charles Gordon Heyd, Chairman of the Board, announced in the annual report for 1952.

A GRANT of $26,954 for the first year of a proposed two-year study was made to the University of Buffalo, New York, by the National Multiple Sclerosis Society on March 10th. The investigation will explore the possible infectious origin of multiple sclerosis. The grant was made possible by a gift of $20,000 from Otto C. Frohnknecht, President, International Minerals and Metals Corporation and member of the Board of Directors of the Society, in memory of his daughter, Mrs. Margaret Frohnknecht Kober, deceased wife of Arthur Kober, author and playwright.

Dr. Ernest Witebsky, Professor of Bacteriology and Immunology of the University of Buffalo, directs this research project.

A MICHIGAN medical team reported that 92 per cent of chronic salmonella carriers studied were successfully treated with chloromycetin. Dr. Ivan A. LaCore, assistant medical superintendent, and John H. Conlin, clinical bacteriologist, both of the Ypsilanti State Hospital, told of the successful chloromycetin therapy carried out on twenty-three of twenty-five salmonella carriers (*Am. J. M. Sc.*, 225: 547, 1953). Patients were selected on the basis of consecutive admissions demonstrating positive stool cultures. Salmonella organisms isolated from these individuals were identified for species, and thirteen different ones were found, including one unknown.

All organisms were sensitive to chloromycetin in concentration of 1.56 to 3.12 μg. per cc., the authors stated.

BETWEEN three and four hundred dentists, including top dental and medical researchers, will be in attendance at the Tenth Annual Meeting of the American Institute of Dental Medicine, at the Desert Inn and El Mirador, Palm Springs, California, October 25 through October 29, 1953. Advance registration, according to an announcement by Dr. Hermann Becks, Director and Founder of the Institute, indicates a capacity turn-out for the five-day study session. Applications and full information on the Seminar program may be secured by writing Miss Marion G. Lewis, Executive Secretary, 2240 Channing Way, Berkeley 4, California.

(*continued on page 58*)

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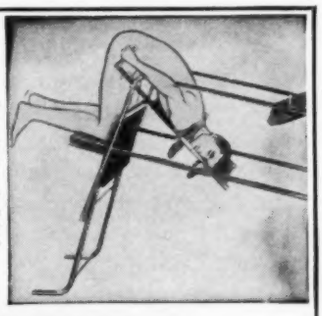

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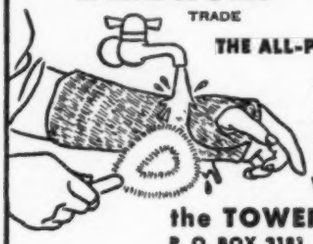

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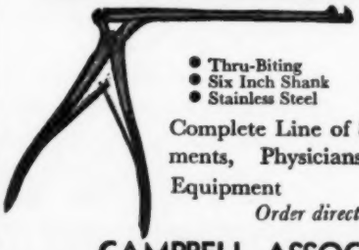

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Outside the Ivory Tower

(*continued from page 56*)

THE National Foundation for Infantile Paralysis makes the following statement upon the recommendation of its Advisory Committees on Research and Education:

"The Office of Defense Mobilization, a governmental agency, has been designated the allocating authority for the nation's entire supply of gamma globulin. Inasmuch as this blood fraction is effective in preventing measles, infectious hepatitis and poliomyelitis, and because this substance is in very limited supply, allocation of the nation's stockpile through a central agency was decided upon as the most effective way to prevent the greatest number of cases of these diseases.

"We have just learned that the Office of Defense Mobilization has announced its plan for allocating gamma globulin for use against poliomyelitis. The basis for the plan as announced was recommended by a special panel appointed by the National Research Council, a quasi-governmental agency.

"We note with some concern that in accordance with this plan, the greater part of the nation's stockpile of this scarce material may be used in a manner for which direct proof of efficacy is lacking. Reference is made here to the recommendation that gamma globulin be administered to household and other intimate contacts of patients suffering from poliomyelitis and, in certain circumstances, even to contacts of individuals suspected of having poliomyelitis.

"The field trials conducted during the summers of 1951 and 1952, with financial support of the National Foundation for Infantile Paralysis, demonstrated that gamma globulin, when administered during an epidemic of poliomyelitis to individuals in those age groups subject to greatest risk, provides some temporary protection against the paralytic form of this disease. Whether or not gamma globulin will be equally effective when used in some other manner is unknown. The field trials further provided suggestive evidence that those individuals who develop poliomyelitis following administration of gamma globulin develop a less severe form of the disease.

"While it is true that in a population group made up entirely of individuals who are contacts of persons with poliomyelitis, there develops subsequently an unusually large number of cases of this disease, it is also true that approximately 75 per cent of these 'secondary' cases occur within six days of the time the first case in the family has been diagnosed. Whether or not gamma globulin will prevent poliomyelitis when it is administered to contacts of diagnosed cases is unknown.

"We know that gamma globulin is not effective if administered to patients after signs of the disease are apparent. We also know that most, if not all, contacts of cases of poliomyelitis are already infected with the virus by the time the first case in the family has been diagnosed. In fact, there is good reason to believe that such individuals might have been infected for a period of several days. IF the blood fraction is to be administered to contacts of cases, the important and as yet unanswered question is 'Has the disease already advanced beyond the point where gamma globulin can prevent paralysis?' There is good reason to believe that there will be many contacts of cases of poliomyelitis who will become paralyzed even though they receive gamma globulin.

"The National Foundation's Advisory Committees on Research and Education have heretofore recommended and continue strongly to recommend that the major portion of the nation's stockpile of gamma globulin, available for use in poliomyelitis, be reserved for mass injections of children in the most severe polio epidemics of 1953. This recommendation is made because it is the only method so far proven to be effective against poliomyelitis. The Advisory Committees recommend further that the smaller portion of this scarce material be used in conjunction with contacts of diagnosed cases of poliomyelitis. It is hoped that, in connection with this latter use, adequate studies may be carried out so that we may learn whether or not gamma globulin employed in this manner can prevent paralytic poliomyelitis effectively."

The National Foundation stands ready to assist State Health Officers who may elect to employ community-wide injections of gamma globulin in an effort to halt an epidemic of poliomeylitis. It is prepared to provide specially trained personnel and such items of equipment as would not ordinarily be available in many communities.

(*continued on page 60*)

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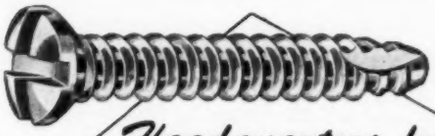

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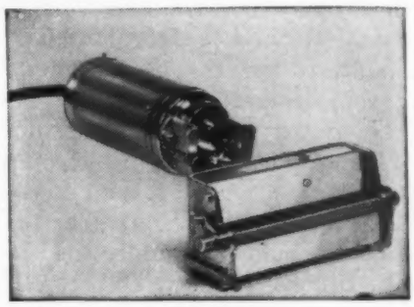

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Outside the Ivory Tower

(*continued from page 58*)

THE Research Advisory Board of United Cerebral Palsy invites nominations for the third annual United Cerebral Palsy—Max Weinstein award for the outstanding recent scientific achievement in the field of cerebral palsy. The award consists of a plaque and $1,000. Nominations should be accompanied by a short supporting statement and be in the hands of the Board by September 15, 1953. Nominations should be addressed to Dr. Glidden L. Brooks, Medical Director, United Cerebral Palsy, 50 West 57th Street, New York 19, N.Y.

THE second Fred H. Albee Annual Lecture on Rehabilitation will be held at the Kessler Institute for Rehabilitation, West Orange, New Jersey, on October 8, 1953. The Albee Lecturer will be Dr. Sterling Bunnell of San Francisco, who will speak on "Tendon Surgery of the Hand." Dr. Bunnell's lecture will be presented in the morning. In the afternoon four panels have been planned on various aspects of surgery of the hand. Dr. Edward J. Flynn of Boston will speak on "Acute Hand Injuries"; Dr. Leonard Goldner of Durham, North Carolina, will speak on "Reconstruction of the Hand Following Cerebral Palsy and Traumatic Spastic Paralysis"; Dr. J. William Littler of New York City will speak on "Phalangization"; Dr. Jerome Gelb of Newark will speak on "Cineplasty in Children." Dr. Bunnell will summarize the program at the end of the day.

Some of the discussors who have been invited are Dr. Herbert Conway of New York City, who will discuss Dr. Flynn's paper; Doctors Emmanuel B. Kaplan and Lee Mayer of New York City, who will discuss Dr. Goldner's paper; Dr. Thomas W. Stevenson of New York City, and Dr. Robert Clifford of Detroit, who will discuss Dr. Littler's paper. Dr. Henry H. Kessler, medical director of the Kessler Institute for Rehabilitation, will be one of the discussors of Dr. Gelb's paper. The lecture is open to all physicians. Those desiring to attend should communicate with the registrar at the Kessler Institute for Rehabilitation on Pleasant Valley Way, West Orange, New Jersey.

IT has been announced that L. W. Frohlich, president, L. W. Frohlich, Inc, New York City, an advertising agency specializing in pharmaceutical and industrial accounts, has been named chairman of the Public Relations and Publications Committee of the Young Presidents' Organization. The appointment was made by the Board of Directors of YPO, which now numbers 539 members in thirty-nine states, all of whom became presidents by the age of thirty-nine of companies grossing at least $1,000,000 a year in sales.

A NEW catalog of isotopes, both radioactive and stable, produced by Oak Ridge National Laboratory, Oak Ridge, Tennessee, is now available. The catalog replaces a previous edition published by the Atomic Energy Commission in March, 1951. Oak Ridge National Laboratory, which is operated for the AEC by Union Carbide and Carbon Corporation, is not only the largest laboratory of its type in this country but is the foremost producer and distributor of radioisotopes and stable isotopes for use in medicine, agriculture, industry and science. More than 100 radioactive and 175 stable isotopes are listed in the new catalog, together with prices and descriptive material. The catalog, at $1.00 per copy, or information about ORNL-produced radioisotopes may be obtained by writing to Carbide and Carbon Chemicals Company, Oak Ridge National Laboratory, Radioisotope Sales Department, Post Office Box P, Oak Ridge, Tennessee.

THERE is no such thing as an "average alcoholic," a Yale University sociologist told a conference on alcoholism. "Problem drinkers," said Robert Straus, Research Associate of Yale's Center of Alcohol Studies, "show wide variance in several characteristics. We have been misled by common alcoholic stereotypes, usually derived from very limited segments of the over-all alcoholic population of the nation. Until quite recently we have been severely handicapped by a tendency to think of alcoholics primarily in terms of their drinking and their personality characteristics, and to minimize the importance of the social characteristic which we now realize may have an important bearing on methods of treatment and chances for improvement."

(*continued on page 62*)

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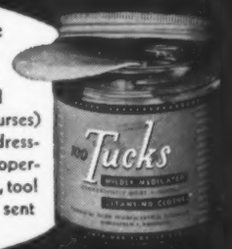

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Outside the Ivory Tower

(*continued from page 60*)

DOCTORS tell us that health and happiness are closely related and that fear of illness is the cause of many of our worries. Much of this fear, we are told, could be prevented if we knew the facts. In an attempt to present these facts properly to the public, Columbia University this Fall will offer a series of ten informal medical discussions designed to give the layman the facts about ourselves and how we can live a healthier, happier life. The series, which will be offered through Columbia's Institute of Arts and Sciences, will present seventeen distinguished authorities in the field of medicine as discussion leaders. The ten weekly evening sessions, beginning the first week in October, will be open to the public on the basis of $15 for the entire series. There are no admission requirements; everyone is eligible. Each week the members of the course, entitled "Here's to Your Health!", will enjoy the unusual opportunity of meeting one or more outstanding medical experts and asking questions which everyone always wants to ask about the heart, hearing, emotional life, weight and blood pressure.

Novel feature of the series will be the demonstrations, with volunteers from the group, of the electrocardiograph, the blood pressure machine, the audiometer, various types of hearing aids and other tools of the medical profession. Miss Gretta Baker, radio writer on medical subjects, will direct the discussions in lively round-table style. There will be a question period after each program. Printed folders are available from the office of the Institute of Arts and Sciences, Columbia University, New York 27, N. Y.

APPLICATIONS for certification (American Board of Obstetrics and Gynecology) for the 1954 Part I Examinations are now being accepted. All candidates for admission to the Examinations for certification by the Board are required to submit, with their application, a plain typewritten list of all patients admitted to the hospitals where they practice, for the year preceding their application or the year prior to their request for reopening of their application. This list should also contain the diagnosis, pathologic diagnosis, nature of treatment and end result in each case.

Attention of all candidates is called to a change in date. Application for examination or re-examination, as well as requests for resubmission of case abstracts, must be made to the Secretary prior to October 1, 1953.

Requests for Applications for Appraisal of Incomplete Training, Applications for Certification, current Board Bulletins and Preceptorship or Supplemental Training Forms should be made to: Robert L. Faulkner, M.D., Secretary American Board of Obstetrics and Gynecology, 2105 Adelbert Road, Cleveland 6, Ohio. Such requests should be accompanied by a large stamped, self-addressed envelope.

THE American Psychosomatic Society will hold its Eleventh Annual Meeting at the Jung Hotel in New Orleans on March 27 and 28, 1954. The Program Committee would like to receive titles and abstracts of papers for consideration for the program by December 1, 1953. The time allotted for the reading of each paper will be fifteen to twenty-five minutes. The Committee is interested in investigations in the theory and practice of psychosomatic medicine as applied to adults and children in all the medical specialties, and in contributions in psychophysiology and ecology. The Program Committee requests that abstracts be submitted in quadruplicate to the Chairman, at 551 Madison Avenue, New York 22, New York.

THE American Heart Association has marked its fifth anniversary as a voluntary health agency by awarding, jointly with its affiliates, an additional $473,930.59 for eighty-nine research grants-in-aid in the field of heart and blood vessel diseases, it was announced by Dr. Robert L. King, President of the Association. Dr. King noted that the latest awards increase to a grand total of almost $6,500,000 the sums spent for research studies by the American Heart Association and its affiliated state and local associations over the five-year period. The newly approved grants-in-aid were made possible by public contributions to the 1952 Heart Fund campaign. They provide for investigations to be conducted in a wide area of applied and basic research during the 1953–1954 fiscal year.

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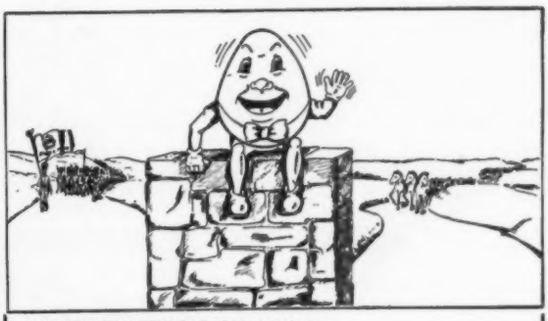

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1. *DeBakey, M.E., and others: Treatment of wound shock, in Symposium on Shock, Washington, D.C., Army Medical Service Graduate School, May, 1951.*

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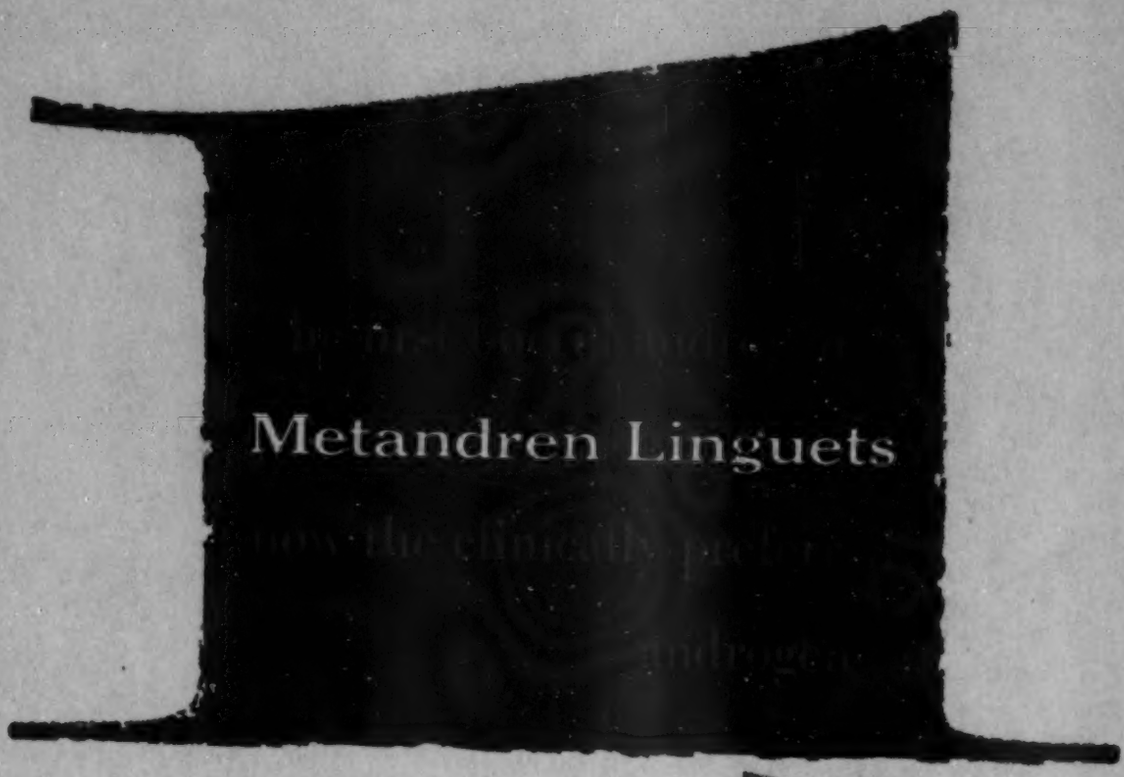

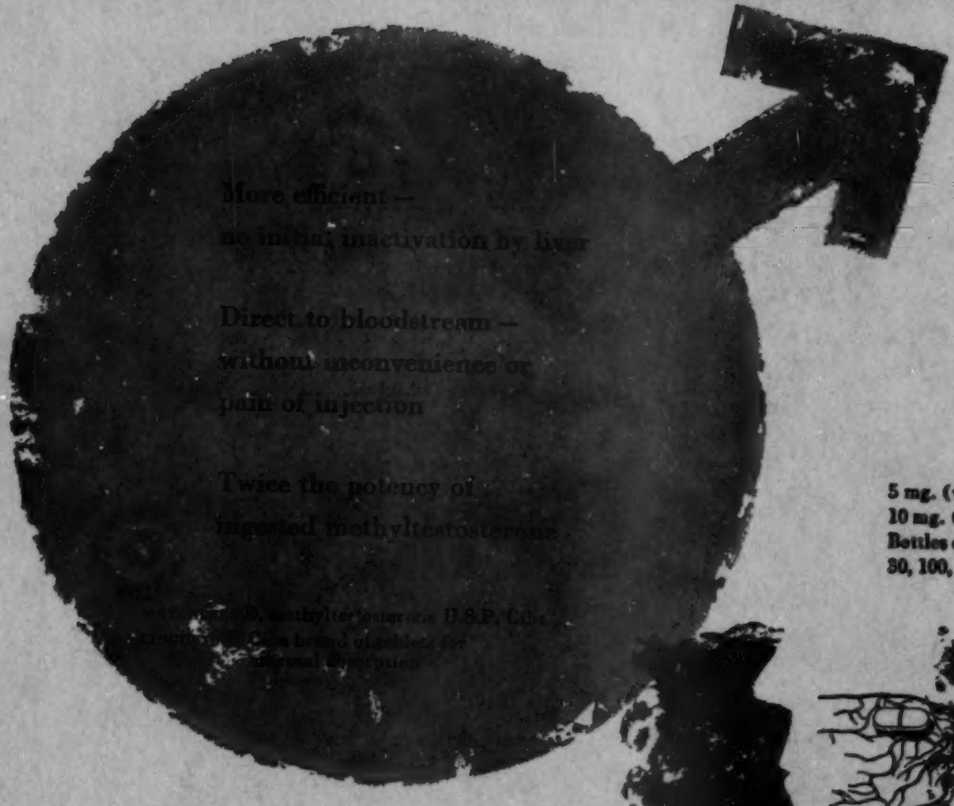

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